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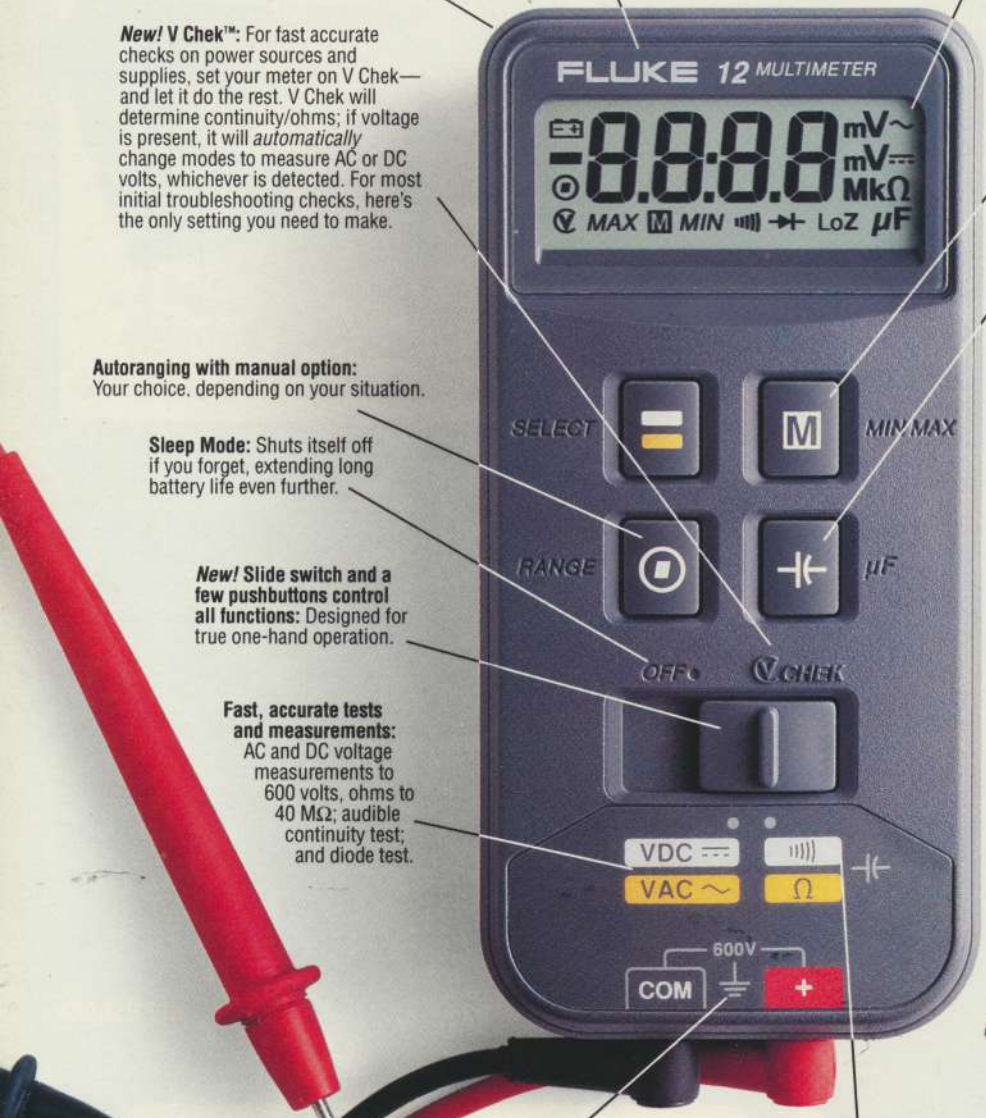

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CONSTRUCTION ARTICLES

BUILD AN EIGHT-CHANNEL AUDIO SWITCHER ..... *Tim Goebel* 31
Take command of your audio system with this deluxe, expandable control center

BUILD A TALKING COMPASS ..... *Larry Mitschke* 42
You'll always head in the right direction with this interesting, novelty compass

BUILD A VOICE DISGUISER ..... *Vincent Vollono* 53
Have loads of fun fooling friends and family when they call with this simple frequency-shifting circuit

BUILD A HOLIDAY-LIGHT TESTER ..... *John Yacono and Marc Spiwak* 59
Christmas should be a time for peace and joy—not for wrestling with lights that won't glow

FEATURE ARTICLES

INSTALLING AND TROUBLESHOOTING CAR-AUDIO SYSTEMS ..... *Wayne R. Gipson* 35
These valuable hints and techniques can help you install a car-stereo system like a pro

KIT BUILDING LIVES: The Ramsey Two-Meter FM Transceiver Kit ..... *Elliott S. Kantner* 39
This kit provides you with a valuable and enjoyable learning experience, and a polished, working unit

MAKING THE CONNECTION ..... *Joseph J. Carr* 45
The link between your antenna and your rig can mean the difference between great reception and mud

NOT ANOTHER OP-AMP ARTICLE ..... *Robert Dougherty* 57
Learn how op-amps work from an intuitive, plain-language point of view

PRODUCT REVIEWS

GIZMO 5
Including: Gizmos for the holidays, NSM 100-disc CD changer, and lots more

PRODUCT TEST REPORT ..... *Len Feldman* 26
Audio Technica U.S. SM-502 audio mixer

HANDS-ON REPORT 62
Philips ECG instant cross-reference software

COLUMNS

ANTIQUE RADIO ..... *Marc Ellis* 64
Reassembling the Sky Buddy

COMPUTER BITS ..... *Jeff Holtzman* 66
WordBASIC II

CIRCUIT CIRCUS ..... *Charles D. Rakes* 68
MC14538 monostable applications

THINK TANK ..... *John J. Yacono* 72
Do you compute?

DX LISTENING ..... *Don Jensen* 76
United Nations radio

HAM RADIO ..... *Joseph J. Carr* 78
DX'ing the low bands

SCANNER SCENE ..... *Marc Saxon* 80
Monitoring remote news crews

DEPARTMENTS

EDITORIAL ..... *Carl Laron* 2
LETTERS 3
FACTCARDS 49
POPULAR ELECTRONICS MARKET CENTER 50A
FREE INFORMATION CARD 51
ELECTRONICS LIBRARY 82
NEW PRODUCTS 85
ELECTRONICS MARKET PLACE 93
ADVERTISER'S INDEX 96

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EDITORIAL

KIT BUILDING LIVES

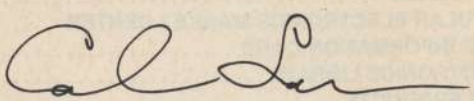
Back in August we commented about the passing of a legend—Heath's withdrawal from the electronics kit business. But in doing so, we may have given some of you out there the mistaken impression that kit building as an activity is dead.

That is far from the truth. Today there are literally dozens of small companies, many of them based in the U.S.A., providing kits of every type and description. While they individually can't match the scope and volume of Heath's efforts in days gone by, collectively they provide an impressive array of electronics kits for nearly any interest or skill level.

For example, this month we report on an excellent offering from today's kit market. The Ramsey 2-meter amateur transceiver kit combines a reasonably priced, quality unit with easy-to-follow instructions and excellent supplementary documentation. The story begins on page 39.

Don't let the demise of one company's kit business convince you to quit building. True, the quality of today's kits, especially when it comes to documentation, can vary. But in almost every case, a patient, careful builder can successfully produce a useful, working unit. And nothing can match the pride of being able to say "I built it myself!"

By the way, as this is our December issue, on behalf of everyone here at Gernsback Publications, I would like to close by wishing you and your family a joyous holiday season and a happy, healthy New Year.



Carl Laron
Editor

LETTERS

HIGH-ENERGY IGNITION SYSTEM

I thought that Charles Ball's article, "Build a High-Energy Ignition System for your Car" (**Popular Electronics**, September 1992) was good. However, I must add a few pointers. First, use the best parts you can afford; otherwise, the extreme hot and cold temperatures under the hood might cause problems. Second, use 8mm spark-plug wires—not the 7mm wires that are standard on some vehicles. It might even be worthwhile to use high-performance wires. Finally, beware of laying the spark-plug wires side by side, which could cause the engine to misfire and/or backfire. That is because the spark energy goes from one wire to another via inductance.

Here's a little history. from 1975 to 1978 (I believe), GM had a hot "high-energy ignition" (HEI) with a 40- to 45-kV spark. but when a spark-plug wire went bad (with time), the high voltage in the distributor would sometimes arc through the plastic parts, causing damage. In addition, some of the spark plugs would get a white (not gray or black) deposit, which was found to be ashes from the hot spark totally burning the gas and oil. By the way, in the mechanic's world, the Kettering ignition officially is called a breaker points ignition.

As you might guess, I was a mechanic for a few years. But I am also an electronic technician. I enjoy both, and I enjoy **Popular Electronics**.

S.P.
Snohomish, WA

THE END OF A LEGEND

I agree with Carl Laron's editorial, "The End of a Legend" (**Popular Electronics**, August 1992), regarding Heath Company pulling out of the kit business. It was the last company to offer quality kits at affordable prices.

As you know, there are several companies that now offer kits, but it is not the same. First, neither the locations or values of parts to be mounted on them are printed on the circuit boards. Second, nine times out of ten the project enclosure is not included with the kit.

I miss the kits that contained everything needed to build and house the finished project, so that all that was needed to come up with a working project that you could be proud to have built was your time and patience.

On another subject, I'd like to ask other readers for help. I've tried every possible way (including contacting the manufacturer) to find a part I need for one of my projects—a National DS-8629N VHF Prescaler IC chip. If anyone can help me I'd appreciate it very much.

John D. Johnson, Sr.
6407 Monroe Avenue
Hammond, IN 46324

Take heart! There are still some nice products out there for dedicated kit builders. In this issue, we review a Ramsey 2-meter FM ham-transceiver kit that has a lot going for it, most notably outstanding documentation. It is available with or without a case, and includes everything you need to successfully complete building the unit.—Editor.

HEARTBEAT BATTERIES

On behalf of Pulse Metric, Inc., I wanted to thank **Popular Electronics** for featuring our DynaPulse 200M/Home Version in *Gizmo* (September, 1992). The article exhibited a clear picture to the reader of the need to monitor blood pressure. Because it displayed how simple it is to use the DynaPulse 200M, I am certain that the article will encourage readers to become more involved in monitoring their blood pressure.

I wanted to address the author's concern about the accuracy of the DynaPulse as the batteries become low. The DynaPulse has a feature that informs the user that the batteries are low. Because the DynaPulse automatically is switched on and off by the program software, and it is only powered when actually making a measurement, we conservatively estimate the battery life to be one year given a usage rate of three measurements a day, every day.

Brenda K. Laird
Pulse Metric, Inc.
San Diego, CA

REJUVENATING CAMCORDER BATTERIES

I'd like to know if you have in your bag of tricks a circuit that I can use to rejuvenate 9.6-volt camcorder batteries. I have a JVC camcorder and some of the batteries only last 15 or 20 minutes (after a full charge) instead of 45 minutes to an hour as they did when new. I read Fred Blechman's "Super Simple NiCd Battery Rejuvenator" (**Popular Electronics**, September 1992) and I wonder if that circuit could be used on my batteries. Please help if you can—I hate the thought of replacing the batteries at $50 each.

C.B.
San Antonio, TX

Your 9.6-volt camcorder battery is probably composed of eight 1.2-volt NiCd cells in series. In that arrangement, usually one or more of the eight cells goes bad, effectively ruining the entire pack.

You might also be dealing with "NiCd memory, , where the cells retain a memory of their last discharge point and tend to quit there. The solution (if the cells are not bad) is to "deep discharge" well below the point at which you normally recharge. I have no idea what current your camcorder draws, but I'd assume one ampere. If you use a 10-ohm, 15-watt resistor directly across the battery terminals, you'll be discharging at less than one ampere. Do that for two hours. Then recharge as you normally do, and discharge for three hours. Then recharge followed by another three-hour discharge. After all that, your battery should be in good shape—unless you have a bad cell. As for "zapping" (per my article), that is only practical with "individual" cells, not series-connected ones.—Fred Blechman

PLASMA ACOUSTICS BACKGROUND

I just read John Iovine's article, "Experiment with Plasma Acoustics," in the October issue of **Popular Electronics**, and I thought I'd let him know that it's nothing new. Sometime in the late 1940's or early 50's either the old *Popular Electronics* or *Radio-Electronics* had an article by Ivan K. Keaton on using a flame for a speaker. But even before that article was printed, I did quite a bit of research along those same lines in 1948. We tried just about everything as far as flame goes. The flame that worked the best was unfiltered water gas or city gas, coal gas, and fuel oil. It seemed like the dirtier the flame, the better it worked. As for electrodes, the best ones are oil-burner igniters because they are mounted in porcelain tubes and they come in different lengths and wire gauges. If you mount the electrodes on a ¼-inch rod, as far from the flame as possible, you will get 360-degree sound that's much clearer. For seeding, there are any number of things that you can use to ionize the flame. Potassium nitrate is just one; most any of the nitrates that you can dissolve in water or in a very light oil will work. We tried charcoal, coal dust, mica dust, powdered iron, etc.

It was a great article and brought back a lot of memories.

V.W.
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NSM CD3101 FAVORITE PROGRAM SYSTEM 100-DISC CD CHANGER. From: EuroSon America, Inc., 694 Fort Salonga Road, Northport, NY 11768. Price: $4000.
CD SOUND MUSIC MANAGER SOFTWARE. From: Gefen Systems, 6261 Variel Avenue, Suite C, Woodland Hills, CA 91367. Price: $995.

CIRCLE 50 ON FREE INFORMATION CARD

We occasionally have to remind ourselves that the compact disc has been around for only a decade. The CD seems so much a natural part of our lives that it's difficult to remember the pre-digital days of the vinyl LP. We were only too happy to put behind us the days of manually cuing each album and trying to accurately cue up individual tracks—not to mention dealing with skips and scratches.

Perhaps it's only human nature that the more you have the more you want. We first thought that our CD player was the ultimate in convenience—the discs were easy to handle and store, and we could program the tracks to play in any order we wanted. Although we're quite embarrassed to admit it, we soon found ourselves getting sloppy, and not always returning our discs to their jewel boxes. (Even that began to seem like too much trouble!) And as much as we liked re-arranging the order in which the tracks played back, we wanted to listen to selections from several different discs.

A CD changer satisfied our complaints for a while. But then we started to find ourselves with five or six discs that had to get back into their jewel boxes.

Apparently the people at *NSM* were thinking the same way. Their *Favorite Program System CD3101* appears to be the world's most convenient CD player. The FPS can hold up to 101 of your favorite discs, and play them back in many different ways depending on your mood—and your programming instructions.

The FPS consists of two units: a control unit that looks and acts like a standard single-disc CD player, and a "Disc Library" changer that holds 100 discs. Installing the system is just about as easy as installing a standard CD player. The control unit is connected to your amplifier or receiver by a set of standard audio cables. The only difference is that the FPS CD-3101 gives you a choice of a line-level output or a variable output whose level can be set using a remote control (which is a great convenience if your amplifier lacks a remote volume control).

The control unit and the changer are connected by two cables. One is a fiber-optic cable that carries a digitally coded optical audio signal for both channels. The other is a 9-pin RS-232 cable that carries serial data between the controller and changer. An RS-232 interface is the same kind of serial interface found on a personal computer, and its presence makes it possible to control the changer from your PC if you have the right software. As we'll discuss in detail shortly, we found that to be a useful option.

The disc library is a black metal box that measures 18½ (h) × 13⅝ (w) × 8¼ (d) inches. Our initial reaction was that the changer was rather small. (We still think so, even though we found that it wouldn't fit in many entertainment centers.) It's likely that you'd opt to mount the disc library in a remote location, since it can be operated completely from the control unit's front panel. The six-foot cables that are supplied with the unit are not long enough for such a setup, but obtaining longer cables should be possible. You don't want to mount the disc library too remotely, as it's likely that you'll occasionally need to have access to it.

The disc library is an elegant piece of engineering. The disc reader is mounted on the bottom of the library, in between two 50-disc magazines. When a disc is chosen for play, an elevator mechanism rides up a rear-mounted shaft, pulls the disc—which is contained in a carrier tray—out of the magazine, and lowers it to the disc reader. We like the idea of using a carrier tray, which allows the disc to be

TURN PAGE FOR CONTENTS

This month in GIZMO®

EuroSon America's NSM CD3101 100-Disc CD Changer ..... pg. 5

Gefen Systems' CD Sound Music Manager Software ..... pg. 5

Sony EV-S300 Hi8 VCR ..... pg. 7

Sanyo MCD-Z85 Portable Audio System ..... pg. 12

Gizmos For Christmas ..... pg. 14

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handled only from its center hub, and not grabbed by the edge of the disc. Changing discs seemed to be very quick—in our tests it averaged about six seconds, depending on how far the elevator had to travel between depositing the old and selecting the new disc. The library is immune to mistracking caused by even significant external shocks. (Since the mechanism is the same one used in the NSM jukeboxes that you'll see in bars and other public places, it had better be able to withstand rough handling!)

The control unit is a modified Philips single-disc CD player. It offers the features you would expect from a standard CD player, plus the controls to operate the disc library. When you turn on the control unit, the interior of the glass-fronted library is illuminated by a soft light. The control unit display will read the disc in its single tray, or it will display an "insert disc" instruction. If you're interested in playing one of the discs in the library, you can select it by hitting the DISC button, followed by its two-digit identifier. The selected disc will be lowered to the playing position, and can be played, programmed, or scanned.

To help you keep track of the library contents, the system comes with two three-ring binders containing clear-plastic inserts to hold the printed booklets usually supplied with CD's. Self-stick numbered labels are also provided, so that you will know how the discs are numbered in the library.

The system requires a good amount of effort to set up so that it can be used as intended. Loading one hundred discs is a time-consuming job in itself, as is placing the CD booklets in the binders. (We started out by alphabetizing our rather randomly sorted discs, which also took quite a bit of time!) After your favorite discs are loaded, the programming *fun* begins.

Programming the system requires a lot of time, thought, and patience. The job is made more difficult by a poorly written (translated) manual. It instructs, for example, "If you wish to store all tracks off a CD, key in 00, a number may not then have been chosen beforehand." We have yet to figure out what the manual was trying to say, although we did manage to program the unit on our own.

The most powerful feature of the system is its FPS or favorite-program system memory. Up to 99 FPS programs can be stored, and up to 100 tracks (or complete CD's) can be stored in a given FPS program. The total memory, however, is limited to 4000 items.

One FPS memory might contain rock-and-roll selections, with another containing classical recordings. Other FPS programs could contain music you were inclined to listen to while relaxing after a hard day's work, music for a romantic dinner, or dance music for a party. A restaurant could use FPS memory to provide what would seem like a constantly changing playlist, and run one program at lunchtime (a different one for each day of the week), and another for the Friday-night crowd. We found 99 FPS programs much more than we needed for our personal use. But if we had more magazines—extra 50-disc magazines are available separately—we could see the need.

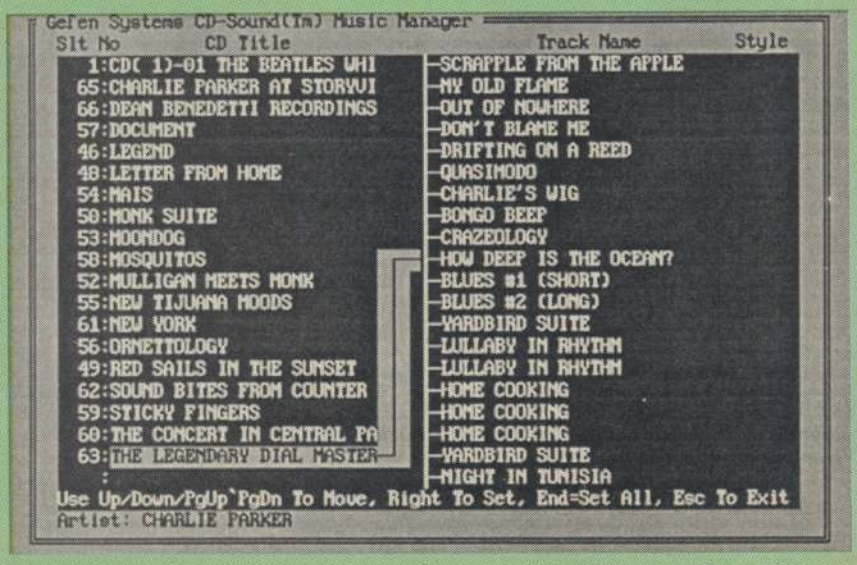
One way to program the system from the control unit is to use the "direct program" mode. Simply choose the tracks you're interested in, and hit the STORE key. When your program is complete, use the FPS key, followed by a two-digit identifier, to store the program in the player's non-volatile memory.

You can also store a program using the system's scanning mode, in which the first 10 or 20 seconds of each track are played in turn. Just hit the STORE key at each track you want to be included in the program. (A NEXT key can help to speed the process.)

As powerful as the program functions on the FPS CD3101 are, we wished for an additional feature—random playback between discs. We wanted, for example, to store our dozen Charlie Parker CD's in one FPS memory, and play them back in random order so that we wouldn't end up listening to the same tracks over and over again every time we selected that program. The only way we could do that was to store each track on each disc in memory (instead of treating each disc as a single item), and then play it back randomly. As we said previously, whoever programs the system needs patience!

An alternate way to program the system is to use a personal computer. We tried the *CD Sound Music Manager* from *Gefen Systems*, which runs on PC-compatible computers.

The main advantage of using a computer and software is that making a playlist is



Choosing a track to add to your playlists is easy with the CD Sound Music Manager.

easier. You can choose from an on-screen menu, for example, to play "All the Young Punks" from the Clash's "Give 'em Enough Rope" CD instead of choosing track 10 from disc 12. Of course, before you can select a song title from the software menu, you have to create the menu by entering information on your discs into the program's database. (An alternative to typing in the text is to have the program automatically insert track numbers. To us, that seems to defeat the purpose of using a PC instead of the front-panel keys.)

There are a number of different ways to create playlists. One way is to hand-pick tracks from your discs. You can also let the program choose selections for you. You can, however, give it guidance by letting it know what CD's to choose from, or what music style you want to hear. (When you enter the data, you can assign each track one of 18 music categories from rock and pop to Zydeco and world beat. Because of a bug in our copy of the software, our choice of categories was limited to four: rock, pop, classical, and jazz.) It's possible to "lock out"songs that you dislike from being chosen. The Music Manager software lets you print playlists, the library contents, and/or lists by style.

Because many users might object to using a PC just to listen to music, Gefen offers a remote control and a remote video option that lets you use a TV or monitor as the program's display. Up to four disk libraries can be linked together for control of up to 400 CD's.

The NSM CD3101 is a versatile system for anyone who has a large library of CD's. We liked the convenience of being able to play our discs without ever having to handle them. If we felt like listening to bebop for a few hours, we would just select FPS 10. Rock and roll? FPS 5. Classical music? FPS 12.

We liked the convenience of the CD Sound Music Manager software, but didn't like turning our PC on every time we wanted to listen to some discs. (We didn't have the opportunity to try out Gefen's remote-control and remote-video options.) Since you can't have both a PC and the control unit hooked up simultaneously, we found ourselves going back to the control unit—after all, we had already programmed it. In a business application, a restaurant, for example, Gefen's software would make more sense.

If not for the $4000 price tag, we'd own the NSM changer now. Since that's a bit beyond our audio budget, we'll have to settle for recommending it highly to anyone considering investing in a big-budget whole-house system. We'll have to go back to what we now see as the great inconvenience of our single-disc player and five-disc changer. But we find it hard to be happy about it. ■

Hi8 Editing VCR

SONY EV-S3000 Hi8 VCR. From: Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656. Price: $1,900.

We admit that we were initially skeptical about the 8mm video format when it was introduced back in the mid 1980's. We're not any longer, and we consider it to be the best camcorder format. We're not going out on a limb by putting our support behind 8mm. It is, after all, the most popular camcorder format—even here in the U.S., where it took longer to catch on than in the rest of the world.

Sony's EV-S3000 isn't a camcorder, however. It's a high-band 8mm VCR deck, Sony's flagship model. Judging by the quality of the record/playback capability, the deck does an excellent job of showcasing 8mm video. The deck's digital time-base correction, digital noise reduction, digital signal processing, and digital comb filter contribute to the high quality.

Because 8mm video is normally considered to be a portable format, a home 8mm VCR might seem like a strange idea. But since many VCR's these days are being sold to people who already own one VHS deck—and who also own an 8mm camcorder—a 8mm deck starts to make sense. The EV-S3000 isn't for everyone, however. It's too sophisticated—and too expensive—for consumers with average needs.

The strongest suit of the EV-S3000 is its sophisticated editing capabilities. But you might not guess that by looking at the front panel, one of the cleanest we've ever seen. Most of the controls hide behind a flip-down door—and on the door itself. A second door hides various input and output connectors. When those doors are closed, the only controls you see on the front panel are the power and tape-eject buttons, a shuttle dial, buttons for forward and reverse frame advance, STANDBY and START/PAUSE controls for synchronized editing, and buttons that let you choose whether the editing controls affect the editing source or recorder. (If your camcorder features Control-L (LANC) or Control-S capability, you can control both the EV-S300 and the camcorder from the EV-S300's front panel.)

With selected Sony Handycam camcorders, the EV-S300 gives you "Advanced Synchro Edit" capability. In that mode, the tape on both the source and recording decks are backed up, and then rolled forward to synchronize them. Although we didn't have an opportunity to try that feature, the result should be improved editing accuracy.

The audio-dubbing capabilities make it possible to add background music, narration, or other audio to the stereo, PCM, digital-audio tracks, which are separate from the hi-fi AFM audio that is normally recorded on an 8mm tape. During playback, you can choose to listen to the original audio, the dubbed audio, or a mix of the two.

When you're not using the EV-S3000 for editing, you'll most likely use the infrared remote control instead of the front-panel controls. The remote is larger than most, about 9 inches long and 3 inches wide. On first glance, it has surprisingly few controls: Twenty five buttons and a shuttle ring are scattered about the remote's large face. Hidden below a flip-up panel are 41 additional pushbuttons.

The remote also sports an LCD readout near its top edge. When the cover is closed, it displays the time, day, date, and the "command mode" of the remote (which allows the remote to control other Sony equipment). When the remote's pan-

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LABORATORY TEST—SONY EV-S3000 8MM VCR

The video frequency response of a VCR is a measurement of how accurately it can reproduce signals of frequencies that it is called on to record. It is measured by recording a multiburst test signal, which, as its name implies, is a signal that contains bursts of several specific frequencies. The recorded signal is then played back and observed on a waveform monitor.

As shown in the table and multiburst test patterns, Sony's EV-S3000 frequency response is down 2.1 dB at 2 MHz and 4.86 dB at 3 MHz. Those excellent results are, as should be expected, somewhat worse in the LP mode, with the response down 5.42 dB at 3 MHz.

The signal-to-noise ratio is a measurement of the amount of unwanted noise on a fixed, flat-field video signal. A red field, used in our lab tests, is usually preferred to measure the chroma signal to noise ratio. AM chroma measurements indicate the strength of the color signal, while PM chroma indicate the purity of the color signal.

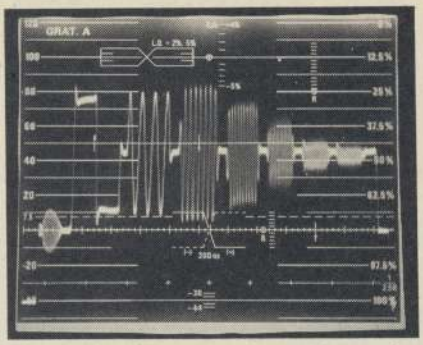
The AM chroma signal-to-noise ratio was measured at 43.8 dB, the PM signal-to-noise ratio was measured at 41.0 dB, both very good to excellent. The color accuracy and the levels of color saturation, as shown in the vectorscope pattern, were good.

The luminance signal-to-noise measurements indicate the brightness and detail that you can expect to see in recorded videos. Such measurements indicate the amount of snow that you're likely to see in the picture. Depending on the reference luminance level used when making the measurement, the luma signal-to-noise ratio ranged from 42.9 to 44.8 in the SP mode, which is very good to excellent performance.

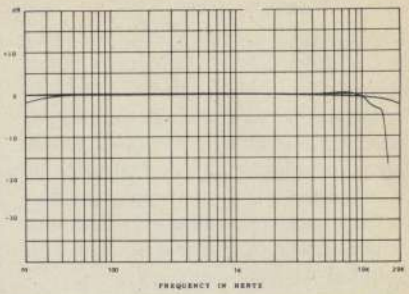
Testing the hi-fi audio section, we measured an output level for a 0-dB reference recorded signal at 0.76 volts at 0.25% THD. The signal-to-noise ratio ("A" weighted) was 71.6 dB, and wow and flutter averaged 0.004%. The frequency response was measured between 20 Hz and 20 kHz was ± 3 dB. We would be very happy with the EV-S3000 as a hi-fi audio recorder.

In the PCM audio mode, our output level for a 0-dB reference level was 1.4 volts with a THD of 3%. Wow and flutter averaged 0.001%. Thanks to the digital recording format, the signal-to-noise ratio ("A" weighted) measured an excellent 81 dB. The frequency response was essentially flat out to 11 kHz, dropping to −3 dB at 12.5 kHz. That's a little worse than we would have expected considering the sampling rate of 31.5 kHz. But because the PCM track is generally used to add narration during post-editing, it's not a serious problem.

In summary, the EV-S3000 does what it is intended to do: It showcases the 8mm video format that Sony is hoping becomes as popular in the home as it has on the road. ■



The multiburst pattern shows the excellent frequency response performance of the EV-S3000 in the SP mode.



The audio frequency response was excellent for AFM recording. The lower-fidelity digital PCM track was flat out to about 11 kHz, dropping to −3dB at 12.5 kHz.

TEST RESULTS—VIDEO SECTION

Frequency Response	
@2.0 MHZ	−2.1 dB
@3.0 MHz	−4.86 dB
Signal-to-Noise Ratios	
Red Field Chroma	
AM	43.8 dB (SP), 41.7 dB (LP)
PM	41.0 dB (SP), 38.7 dB (LP)
Luminance	
100 IRE	42.9 dB (SP), 42.2 dB (LP)
50 IRE	43.6 dB (SP), 42.9 dB (LP)
10 IRE	44.8 dB (SP), 43.9 dB (LP)

TEST RESULTS—AFM AUDIO SECTION

Output Level	
(0 dB reference level, 1 kHz)	0.76 volts, 0.25% THD (SP) 0.75 volts, 0.19% THD (LP)
Signal/Noise ("A" weighted)	71.6 dB (SP), 71.3 dB (LP)
Flutter	.004% avg, 0.006% pk (SP) .020% avg, 0.030% pk (LP)

TEST RESULTS—PCM AUDIO SECTION

Output Level	
(0 dB reference level, 1 kHz)	1.40 volts, 3.0% THD (SP) 1.40 volts, 3.0% THD (LP)
Signal/Noise ("A" weighted)	81.0 dB (SP), 80.0 dB (LP)
Flutter	.001% avg, 0.001% pk (SP) .007% avg, 0.008% pk (LP)

ADDITIONAL DATA

Weight	13¼ pounds
Dimension (H × W × D)	3 15/16 × 18⅜ × 12⅞ inches
Power Requirement	25.5 Watts
Fast Forward/Rewind Time (E6-120)	4:09/4:09
Notable Features	Flying erase head, Digital noise reduction, Timebase corrector, Bidirectional frame advance, Slow motion play ⅛× and 1/10×), Auto indexing, Real-time counter with memory, 1-month/6-program timer, Front-panel A/V jacks, Control-L editing interface, Control-S input.

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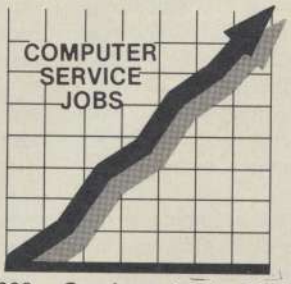

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el is opened, the display changes to its timer-program mode, in which it shows the day, date, command mode, tape speed, and blank spaces for the timer-on, timer-off, and channel information.

Entering the programming information is easy. One key lets you scroll through the day of the week and the date. Changing the turn-on and turn-off time is equally easy. Separate keys allow you to change the hour and minute of each. When you're finished entering the information, pressing the TRANSMIT sends the timer information to the deck.

Some of us found the lack of an on-screen timer menu to be disconcerting. Others of us liked having a VCR we could program without having to turn on the TV to see what we were doing. In a perfect world, the deck would have included both features. To review a list of timer programs (up to six programs, one month in advance), you must use an on-screen menu or the VCR's front-panel display. The remote display can't show that information.

If you want to use the VCR while it's in its timer standby mode, you can temporarily cancel the timer settings with the TIMER REC button on either the remote or the deck. A single button push again restores the timer mode.

Although the EV-S3000 doesn't offer the kind of on-screen programming that many of us have gotten used to, it does offer an on-screen setup menu. One of the setup submenus, "Auto Menu" lets you customize the VCR's operation. For example, you can set it to always rewind the tape when it reaches the end and then turn the deck power off. Another option is to set it to rewind the tape, then go into the timer mode before it shuts off. (Particularly useful if you record the same shows on a daily basis.) Other submenus let you adjust the picture, the tuner presets, and various other VCR and editing settings. The result is that you can customize the deck to operate to your preferences, instead of the other way around.

To help you find the beginning of recorded programs, the deck offers auto index marking—an index mark is inserted at the beginning of each recording. Returning to the index point is a simple procedure. It's also possible to insert and erase index marks manually.

The timebase corrector or TBC does an excellent job of eliminating time-based error known as jitter. Although the main purpose of the circuitry is to reduce picture instability caused by mechanical fluctuations of the tape transport, we found that it was capable of more than that. For an extreme example, we were recording over-the-air signals during a period of "skip" where distant stations were interfering with the locals. The interference was strong enough to disturb the picture's sync and to cause severe picture jitter. The digital TBC was able to produce a stable image.

The two-level digital noise reduction circuitry was very helpful when watching noisy tapes. We normally kept it in its standard mode (which improves the luminance signal-to-noise ration by about 1.5 dB) because we thought that the maximum mode softened the picture noticeably. For noisy tapes, however, the max mode was ideal.

Could the 8mm video format win over the lion's share of the home market in the same way it has captured the camcorder market? Certainly not any time soon. But the EV-S3000 demonstrates that 8mm doesn't have to be limited to portable applications. With the ability to record (in LP mode) up to 5 hours (on a P6-150 cassette), 8mm makes sense for home applications.

If you have no need for editing 8mm tapes, the EV-S3000 is probably overkill (and over-budget), and you'd be better off with an 8mm deck like Sony's $600 EV-A50. But if you've become a video enthusiast who enjoys shooting camcorder footage at every possible opportunity, this VCR could be the editing deck of your dreams. ■

Where's the Box?

MCD-Z85 PORTABLE AUDIO SYSTEM. Manufactured by Sanyo, 21350 Lassen Street, Chatsworth, CA 91311-2329; $449.99.

When we think of "boom boxes"—which, we admit, is pretty infrequently—the image that comes to mind is of an inner-city youth, hunched over to one side to balance on his other shoulder a huge black contraption, from which some strident form of music blares out. Back in the 1970's, when boom boxes first made their appearance, that music was generally some form of disco. Although we hated being subjected to it on city streets or buses, we could understand the attraction that boom boxes held for teens who hated to be without their music. With the advent of the Walkman, however, it's hard to fathom why anyone would want to lug around an awkward, back-straining boom box (except perhaps to make a social statement) in the 1990's.

Yet recent sales figures show that "portable radio combinations" (with tape and/or CD players) have been outselling "portable headset audio" (radios, tape players, radio/tape combinations and CD players) for several years. We might not be seeing (or hearing) quite as many boom boxes on the streets, but apparently they're out there. Or, as we would guess, they're "in there"—in people's homes, that is. Curiosity aroused, we decided to take a closer look at one of today's boom boxes—*Sanyo's MCD-Z85* portable audio system that features a CD player, an AM/FM tuner, and a double cassette deck. The 20-watt system has sophisticated edit-recording capabilities, twin 4-inch speakers with dual bass enclosures, 20 station presets, a CD output jack, two microphone-mixing jacks, Dolby B noise reduction, variable equalizer settings, and a 44-key IR remote control.

It was immediately obvious that this portable radio bears little physical resemblance to the archetypical boom box—it's not boxy. The MCD-Z85 has been streamlined to a sleek oblong shape with few visible features or controls. The dual tape wells are set flush into the top of the MCD-Z85 and spring open with the touch of a pressure-sensitive spot on each. Center front is a backlit, multifunction LCD readout. Only three buttons show on the unit—POWER, PANEL, and CD TRAY. A press of either of the latter two cause the unit's motorized front panel to swing down, revealing the unit's other controls; the CD TRAY button also causes the front-loading CD drawer to slide out. There are surprisingly few controls hidden behind the front panel. A mode-selection button labeled FUNCTION is used to choose between CD, tape, AM, and FM. There are up and down volume buttons, a record button, and a SOUND button that lets you choose between three equalizer settings: normal, vivid, and mild. The stop, play, fast forward, and reverse buttons do double duty, controlling both the CD player and the tape decks. In addition, the fast-forward and reverse buttons are used to tune the radio up and down manually. The only other front-panel control is a round button labeled AI REC for "artificial-intelligence recording."

That button is just the first indication that styling differences are far from the only changes that distinguish the MD-Z85 from its boom-box ancestors. Another good clue is that the portable unit comes with a remote control—an accessory that you're not likely to need if you're carrying the radio around on one shoulder. The inclusion of a remote also lends credence to our theory that people are buying today's breed of boom boxes primarily for at-home use.

While the sparse controls on the front panel can be used for most of the set's

basic functions, the remote puts the MCD-Z85's full power at your fingertips. Besides duplicating the front-panel controls, the remote offers a mute button, a numeric keypad, buttons used to set the unit's timer functions, and a couple of dual-duty buttons. In CD mode, the REP/FM MODE button selects repeat play; in radio mode, it is used to choose stereo or mono play. The EDIT/PS is used to activate the preset-scan function to tune in each preprogrammed station in succession for five seconds each, or to edit CD tracks before taping them.

The MCD-Z85 really shows its stuff when it comes to recording compact discs, offering five different recording modes that are assisted by Sanyo's Artificial Intelligence (AI) technology; the system offers a manual mode as well. In each AI mode, the system scans the tracks on a disc, noting the play time of each, and taking into account the five-second space that is automatically inserted between tracks. You can opt for normal or high-speed (twice the normal speed) recording in the AI modes; manual recording is done only in real time.

Each of the AI modes is easy to use—in fact, our biggest problem was choosing the mode that was best for each of our taping applications. In Auto Edit mode, the system tells you what length tape to use (displayed on the front-panel LCD), and records all of the tracks in their original order. Tracks are not interrupted at the end of side A.

In the Back Skip Edit mode, if the end of side A is reached in the middle of a song, the volume fades out and the song is repeated in its entirety on side B. In the Time Edit mode, the tracks are recorded in their original order unless there is not enough room on the tape for them all to fit. In that case, another selection that will fit is moved up in the recording order to replace the one that is too long.

In the Program Edit mode, you use the EDIT button to let the MCD-Z85 know the length of the tape being used, and then program in the specific tracks that you want to record. The system arranges those selections to best fit on the tape, leaving an unrecorded blank at the end of side A rather than fading out a song that can't fit as in the Back Skip mode.

The Continuous Edit mode allows you to record songs from more than one CD. You can program-in selected tracks on each subsequent disc, or record the entire disc. Recording is put on standby as you change the CD's. The system's manual mode is used when the recording begins in the middle of a tape, or for those tapes where you'd prefer not to have five-second intervals between songs.

Tape-to-tape dubbing and recording from the radio are simple procedures. AI-assisted tape dubbing can be done at normal or high speeds with the press of a button; manual dubbing also is possible. Radio recording can be done in real time, or you can set a timer for unattended recording. You can set the timer to record one time only, or at the same time every day.

The timer also can be used as an "alarm clock" that will wake you with your choice of radio, CD, or tape (no alarm is available). You can also fall asleep to music (or your favorite radio talk show) after setting (in one-minute intervals) the sleep timer to shut off the MCD-Z85 up to two hours later. The sleep and wake-up timers operate independently—you can fall asleep to the radio and wake up to a CD, for instance. You can also wake to a different radio station than the one playing when you fell asleep. A rather nice touch is a fade-in function that gradually increases the volume of the wake-up music to the level that you've selected.

Those CD-, radio-, and tape-to-tape dubbing operations are unlikely to be used when the MCD-Z85 is perched on a shoulder, as are the timer functions. And not only does the unit have functions that are more suitable for home use than portable applications (including CD line-level outputs), but there are several factors that made us think twice about carrying it around.

First, the $450 suggested retail price tag is more in line with a bookshelf stereo system than a portable unit. The cost of batteries also could prove prohibitive to portable use—the set requires ten "D" cells for normal operation and four "AA" cells for memory backup, as well as the two "AAA" batteries that power the remote control! The pared-down front-panel controls limit the functions that you can access without the remote (most annoying was the inability to use the FM/AM station presets), and there's no convenient way to carry the remote with the main unit—you can't tuck it into a secret compartment or attach it with Velcro strips. And, even without the almost unavoidable comparison to portable headphone audio devices, the MCD-Z85 is simply too heavy to comfortably carry around for any length of time—more than 13 pounds, and that's without all those batteries!

For all those reasons, we found ourselves using the set almost exclusively as an at-home audio system—although perhaps an "in-and-around-the-home" audio system would be a more precise description. As such, it was in great demand. In the several weeks that we had use of the MCD-Z85, it found a temporary home not only in the Gizmo offices, but also in the kitchen, on the fireplace mantle in the living room, out in the garage, and on the back deck. In each of those places, the one-piece audio system delivered clear, clean sound—surprisingly good for a boom box—as well as remote-control convenience, and superior recording capabilities.

With its impressive list of features and functions, and its ability to bring CD sound to any room in the house, this is one boom box that's more likely to appeal to yuppies than youths with a need to make a loud musical statement on the streets of the city. Perhaps in the interest of accuracy, the unit should be dubbed a "baby boom-er box." ■

CIRCLE 52 ON FREE INFORMATION CARD

Christmas

ELECTRONICS WISH LIST

For more information on any product in this section, circle the appropriate number on the Free Information Card.

Sony Mini Disc

Mini-Disc Mania

Is there someone on your gift list who thrives on being the first on the block to own any new electronic product? That person will be thrilled to get a *Mini Disc System* from *Sony Corporation of America* (Sony Drive, Park Ridge, NJ 07656). The new portable audio format offers the sound quality, quick random access, and durability associated with compact discs, but also a few bonuses: smaller size, shock-resistance for true portability, and the ability to record your own Mini Discs. Those MD's measure just 2.5 inches in diameter and are housed in protective caddies, so that they closely resemble 3.5-inch computer diskettes. Plenty of prerecorded titles will be available for stocking stuffers, as well. Price: N/A.

CIRCLE 53 ON FREE INFORMATION CARD

Philips Digital Compact Cassette Player

DCC Debuts

That first-on-the-block gift recipient probably has his eyes on another new audio format as well: Digital Compact Cassette, or DCC. The *DCC900* from *Philips Consumer Electronics* (One Philips Drive, P.O. Box 14810, Knoxville, TN 37914-1810) provides the audible sound quality of compact discs, and the convenience and recordability of compact cassettes. The format is "backward-compatible" with existing analog cassettes—it can play them but it can't record them. DCC cassettes are more durable and easier to use than standard audio cassettes, and their digital nature allows the inclusion of text information. The DCC900's 12-character semi-dot-matrix fluorescent display can show the album title, list of track titles, names of artists on each track, etc., whenever that information has been encoded on a prerecorded cassette. Other features include a motorized front-tray loader, playback of analog cassettes with Dolby B and C noise reduction, auto reverse, a headphone jack with volume control, CD synchro-recording, a timer, and a dedicated remote control. Price: $799.

CIRCLE 54 ON FREE INFORMATION CARD

Digital Compact Cassettes

Don't forget to include something to play on that new DCC deck—DCC tape. *DCC Maxima* from *BASF* (Crosby Drive, Bedford, MA 01730), the first DCC tape in production, features a pure chromium-dioxide formulation to optimize digital recording and playback. With its unique DCC shell design, it was named one of the most innovative consumer-electronics products of 1992 at the Summer Consumer Electronics Show. Price: N/A.

CIRCLE 55 ON FREE INFORMATION CARD

Eastman Kodak Photo CD Player

Photo Opportunities

Most people approach the holidays with cameras in hand, ready to snap some shots of the family gatherings and the kids opening gifts. This year, one of those gifts could represent a whole new way of viewing those family photos—on television. *Photo CD* from *Eastman Kodak Company* (343 State Street, Rochester, NY 14650-0519) looks like a standard CD player (and can actually play audio CD's), but it's intended to play photo CD's, optical discs onto which photographs have been "developed" at a photo processing center. Several rolls of film (up to 100 images) can fit on one Photo CD, and you can get paper prints of any photo by bringing the disc back to your processor. With the Photo CD player, those photographs can be displayed on a television (at a much greater resolution than that of broadcast TV). Favorite photos can be selected for replay in the same way you'd program favorite tracks on an audio CD, and those shots you'd rather nobody ever glimpsed can be deleted from the playback sequence. You can even zoom in on a photo and "crop" it on screen—without decreasing its resolution. A five-disc carousel model also features on-screen display of the image number for easy indexing. Prices: from $400.

CIRCLE 56 ON FREE INFORMATION CARD

For more information on any product in this section, circle the appropriate number on the Free Information Card.

Christmas

ELECTRONICS WISH LIST

Pictures by Phone

Another way to see family members displayed on a video screen is with the *VideoPhone 2500* from *AT&T* (5 Wood Hollow Road, Parsippany, NJ 07054)—and we're talking full-motion, real-time video at 10 frames per second, not still shots. If there's a friend or family member living in a far-off state who you'd like to see more of, consider exchanging VideoPhones this year. The VideoPhone displays continuously moving color images, allowing you to see the person or people at the other end—only when they want to be seen, thanks to privacy-protection features (no need to worry about getting caught on a bad hair day, or wearing only a towel!). A self-view mode even lets you make sure you're looking good before making a video phone call. With a fixed-focus lens that clearly shows everyone within nine feet of the phone, and a built-in speaker phone, the whole family can get in the picture, and into the conversation. No special installation is required. Price: $1499.

CIRCLE 57 ON FREE INFORMATION CARD

AT&T VideoPhone 2500

Sports-Minded Camcorder

For those on your gift list who prefer to stay behind the camera while participating in all the action, *Hitachi Home Electronics (America)* (3890 Steve Reynolds Blvd., Norcross, GA 30093) offers the *Surf-N-Snow VM-SP1* 8mm camcorder. With rubber-sealed controls and hatch and a specially coated lens, the camcorder is water-resistant and will float (though it's not submersible). Take it along to the beach, the ski slopes, and on mountain hikes without a worry. The Surf-N-Snow features Hitachi's AccuShot auto-exposure system, artificial-intelligence-assisted iris and white balance, a 16× digital zoom lens, zoom special effects, a graphic titler that can superimpose up to 53 different images over a scene, a remote control, a variable-speed shutter, and an array of features to simplify editing. Price: $1499.

CIRCLE 58 ON FREE INFORMATION CARD

Hitachi Surf-N-Snow Camcorder

8mm Tape Saver

That sportsman/videographer won't need to worry about the 8mm tapes he brings along on his outdoor adventures, either, if the *8mm Sports Case* and *Sports Metal-HG 8mm Video Tape* from *Sony Corporation of America* (Sony Drive, Park Ridge, NJ 07656) are in his Christmas stocking. Intended for use outdoors, the tape boasts 40% better picture quality than standard metal 8mm tape. The Sports Case is a shock-resistant, water-resistant cassette case made of sturdy rubber that helps keep out dust, dirt (even sand), and moisture that can put video recordings in jeopardy. Price: $14.99 for both.

CIRCLE 59 ON FREE INFORMATION CARD

Video Reporter Kit

Lately, local and even national news programs have broadcast home-brewed videos that were filmed in conditions that would seem to require shock- and water-resistant camcorders and tapes—tornadoes, hurricanes, earthquakes, and riots come immediately to mind. If there's a news-minded, budding videographer on your gift list, *Ambico Inc.'s* (50 Maple Street, P.O. Box 427, Norwood, NJ 07648-0427) *Video Reporter Kit* provides the tools to get him or her started. It includes a fanny pack for hands-free storage of spare batteries and videotapes, a telephoto lens to bring the action close up, and a narration headset designed to eliminate distracting noises while the user narrates the events as they unfold. In addition, the kit provides a camcorder "raincoat" to protect the camcorder in inclement weather, a *News Service Telephone Directory* listing most major U.S. television stations that buy home videos for broadcast, a flashlight, a pen, and a notepad. All that's missing are press credentials. Price: $99.95.

CIRCLE 60 ON FREE INFORMATION CARD

Sony 8mm Sports Case

Christmas

ELECTRONICS WISH LIST

For more information on any product in this section, circle the appropriate number on the Free Information Card.

Audio-Technica Wireless Microphone System

Wireless Microphone System

Serious videographers would appreciate receiving a professional-quality wireless microphone system from *Audio-Technica U.S., Inc.* (1221 Commerce Drive, Stow, OH 44224). The *ATR45W* consists of an RF transmitter and receiver plus an omnidirectional, lavalier, condenser microphone. The system operates on the 170-MHz band, which is the band used by professionals, instead of the 49-MHz band used by most consumer wireless systems. The higher operating frequency provides improved range—up to 500 feet in line-of-sight operation—and extended high-frequency response. Each unit actually has two selectable frequencies, so if you experience noise or interference on one, you can simply switch to the other. The wireless system comes with a camera-shoe mount, Velcro strips for use when a shoe mount is unavailable, belt clips, an earphone for monitoring the recording, and the *ATR35* microphone with tie clip and windscreen. Price: $239.95.

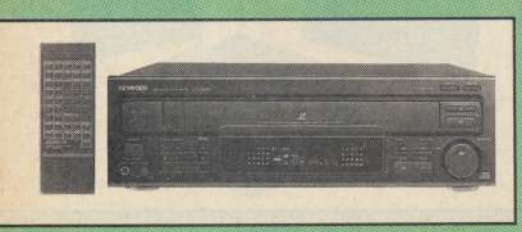
CIRCLE 61 ON FREE INFORMATION CARD

Panasonic SuperFlat TV

SuperFlat TV

Let's face it—we probably know more people who'd rather sit in front of a TV than be out making videos. *Panasonic Company* (One Panasonic Way, Secaucus, NJ 07094) is a firm believer that the flatter the screen, the better, and their *CTP-3180SF SuperFlat System TV* delivers high-end features at a (somewhat) reasonable price. The 31-inch set features a screen that's 30% flatter than those of conventional sets, which presents a much wider field of vision and reduces light reflection from its ultra-dark face plate, resulting in a 46% increase in contrast. The TV is capable of over 700 lines of horizontal resolution, and two S-Video inputs are provided. The television's "Dome Sound System" places the speakers in the rear of the set, with sound fired through two nearly invisible grilles on the sides of the screen, and includes dbx noise reduction. Bass, treble, and balance can be adjusted using on-screen menus. The CTP-3180SF also features surround-sound circuitry with three surround modes (for movies, music, and mono sources). The on-screen menus are also used for function selections, picture alterations, and clock and timer settings. The set's universal remote control operates all recent Panasonic VCR's and most other VCR's and cable boxes. Price: $1299.95.

CIRCLE 62 ON FREE INFORMATION CARD



Kenwood Laserdisc Player

Laserdisc Player for the Lazy

True film lovers would love to receive a laserdisc player on which to play their favorite flicks. *Kenwood's* (P.O. Box 22745, Long Beach, CA 90801) *LVD-820R* offers an attractive convenience feature—autoreverse for uninterrupted videodisc viewing. When side A is finished, the player automatically switches to side B of the disc, eliminating at least one trip from the couch. The LVD-820R plays 12- and 8-inch laserdiscs in both CAV and CLV formats, 5- and 3-inch compact discs, and CD-V discs, all with no special adapters. A shuttle knob allows variable-speed fast-forward or reverse scanning. The "memory stop" feature works like an extended pause function, remembering the spot on the disc so that viewing can be resumed exactly were it was stopped for as long as the power remains on. The "midnight theater" feature automatically adjusts the signal level so that quiet dialogue passages are louder and dynamic sound effects are softer, for a more consistent sound level that will allow other family members to sleep a little easier. Price: $899.

CIRCLE 63 ON FREE INFORMATION CARD

For more information on any product in this section, circle the appropriate number on the Free Information Card.

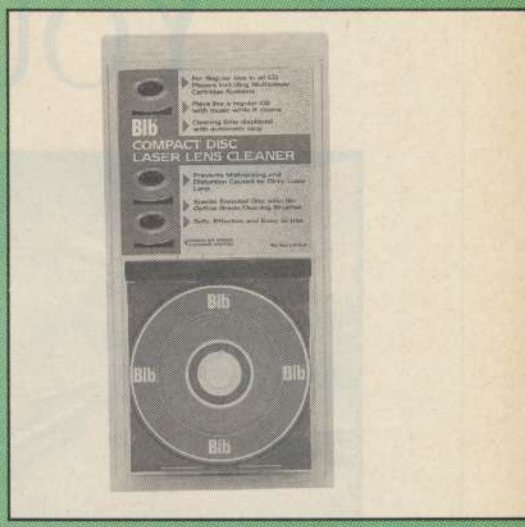
Christmas

ELECTRONICS WISH LIST

Laser Lens Cleaner

CD players, like laserdisc players, rely on lasers and lens systems to read data from discs. Dust or other pollutants can prevent a CD player from reading the binary code printed beneath a disc's surface. The player's error-correction system can compensate only so much. Any audiophiles on your list will appreciate *Bib America's C-639/A Compact Disc Laser Lens Cleaner*, which can restore the precision reading capability of a CD player. The cleaner plays music like a regular CD while it cleans, and automatically stops after 60 seconds. Six optical-grade brushes create a wave action while the cleaner is rotating, providing a safe and effective way to clean the player's laser lens. The laser-lens cleaning system also can be used on CD-ROM systems. Price: $34.95.

CIRCLE 64 ON FREE INFORMATION CARD



Bib Laser Lens Cleaner

Compact Disc Bath Time

A clean laser lens can do nothing to help a dirty CD. That's why *DiscWasher* (46-23 Crane Street, Long Island City, NY 11101) offers the *CD Hydrobath*, a non-contact disc-cleaning system. Only the CD6+ cleaning solution touches the disc's surface. That solution effectively removes dirt and debris from all CD's, including CD-I and CD-ROM discs. The system consists of the cleaning solution and a compact, self-contained housing that uses a high-speed rotation platform to spin the disc clockwise for 30 seconds, as a stream of CD6+ is pumped against the disc's playing surface. That creates a vigorous foaming action to break up accumulated deposits of dirt and grease. The unit's drive motor then reverses direction, spinning the CD counterclockwise at an even higher speed for 15 seconds to dry the disc, completing the cleaning process. The solution is recycled through a built-in filter, which traps all contaminants to prevent them from being redeposited on the next disc. Up to 100 CD's can be cleaned in 2 ounces of CD6+ in a single cleaning session. A 6-ounce bottle is included. Price: $59.95.

CIRCLE 65 ON FREE INFORMATION CARD

Discwasher CD Hydrobath

CD-Storage "Speakers"

Your audiophile friends and relatives probably could use a place to store their dozens of discs. The *Sky Disc* storage unit from *Memtek Products* (P.O. Box 901021, Fort Worth, TX 76101) holds up to 50 CD's. The sleek, 2½-foot tall unit is designed to look just like an audio speaker. It would make a great gift for anyone who has replaced his old speakers with new, compact models, but misses the substantial loudspeakers of decades past. Price: $29.99.

CIRCLE 66 ON FREE INFORMATION CARD

Car CD Case

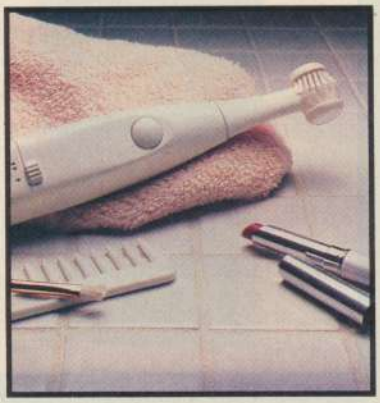
If you're looking for a gift for a friend who has a CD player in his car, you shouldn't have to look further than the *CD FlipDisc* carrying case from *Laserline* (4045 Clipper Court, Bayside Business Park, Fremont, CA 94538). Designed with safety in mind, the case allows easy, one-handed retrieval of discs. Models *FC 12* and *FD24*, with 12- and 24-disc capacities, respectively, feature interconnected jewel-box type disc trays that open out accordion-style with flexible hinges. Pushing down on the first disc tray automatically pulls the next tray into position for retrieval. All the CD's can be accessed in that manner. You can also hold the case in one hand and flip through the disc selections as if turning the pages of a book. A one-touch, spring-loaded latch mechanism pops the case open and snaps it securely closed. The case protects discs from the temperature extremes in cars, and a wrap-around, tongue-in-groove track makes it dust and water resistant. Price: $9.99 (FD12) and $14.99 (FD24).

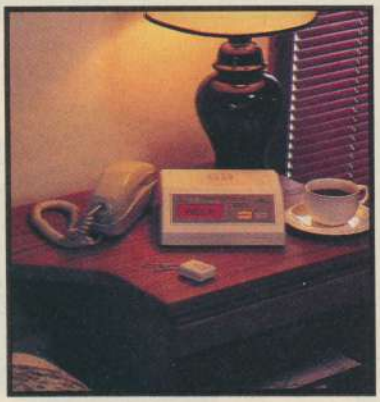
CIRCLE 67 ON FREE INFORMATION CARD

Laserline CD Case

HOLIDAY SPIRIT

YOUR HOLIDAY EL





Holiday Spirit is your complete electronic headquarters for surviving the holidays! Whether you need tips on the latest technology in sound systems, computers or televisions, electronic gift-giving ideas or even batteries, *Holiday Spirit* will provide the latest information on electronic technology, just in time for the holiday season.

Hosted by American's favorite weatherman, Spencer Christian, *Holiday Spirit* is three one hour television show to guide america through their favorite holidays: Thanksgiving-Christmas/Hanukkah-New Year's

Holiday Spirit informs- National Gaurdian Security System is designed for people who want independent lifestyles, even though they may have a medical limitation.

Holiday Spirit entertains- The Bose Lifestyle Music System is a sound system with high performance to enhance any party.

Holiday Spirit educates- A Packard Bell Computer is high value at an economical price for home office, home or small business.

Holiday Spirit teaches- Oralgiene electric toothbrush and EpiSmile toothpaste provides proper oral hygiene methods.

Before you know it, the countdown begins: one month...three weeks...two days, and you have

ECTRONICS CENTER

nothing done! Dad wants a new television, Mom wants a new household gift, Brother wants new audio electronics and sister just wants her gifts to work. *Holiday Spirit* says no problem! *Holiday Spirit* is committed to taking your streesful holiday blues away this season and filling them up with memories to share with family and friends.

Holiday Spirit conserves - A Sunbeam Electric Blanket will warm you during cold nights and save you money on your heating bill.

Holiday Spirit amuses- The Hitachi Ultravision will educate viewers on big screen TV technology.

Holiday Spirit guides- OHM Acoustics Walsh Five speakers are the perfect gift for any music lover.

Holiday Spirit prepares- EverReady Batteries are available for any electronic holiday need.

Holiday Spirit advances- KINYO introduces the latest in video accessories, a search/index device for VHS tape.

Holiday Spirit –bringing technology to the home and making holidays fun again! Watch for us this fall.

Check your TV guide for local listings.

Brookstone Production Company

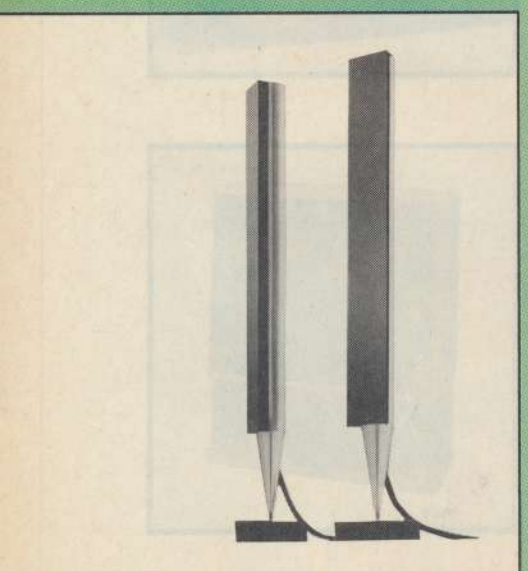
Christmas

ELECTRONICS WISH LIST

For more information on any product in this section, circle the appropriate number on the Free Information Card.

Aiwa Personal Stereo

Koss Amplified Speakers



Bang & Olufsen Loudspeakers

Taking it on the Road

One last gift suggestion for CD enthusiasts. The *PF-795 CD Player Car Stand* from *Geneva* (9909 South Shore Drive, Plymouth, MN 55441) lets you mount a portable CD player in a car. Its foam suspension system virtually eliminates skipping by cushioning the player and absorbing the bumps of even the roughest roads. The stand features a flexible arm that lets the user maneuver the stand into almost any position. It is easy to install in any model car, and includes Velcro fasteners to connect any portable CD player. Used in conjunction with the *PF-578 Stereo Compact Disc Cassette Adaptor*, the car stand provides a simple, effective way to take CD sound on the road. Price: $59.95 (adaptor, $24.95).

CIRCLE 68 ON FREE INFORMATION CARD

Headphone Stereo with EQ

Music lovers on your list will be able to "see" their music when they play it on the *Aiwa America* (800 Corporate Drive, Mahwah, NJ 07430) *HS-PX1000*. The personal stereo is the only one to provide a four-pattern preset graphic equalizer and a large LCD six-band spectrum analyzer. At the touch of a button, the unit's graphic equalizer offers four types of presets: jazz, rock, pop, and flat. The selected pattern is prominently displayed on the extra-large LCD readout to impress your friends. The unit's "private listening sound system" (PLSS) prevents music from escaping from the headphones even at high volume levels, presumably so that only the user will know that he's damaging his hearing. A full-function remote control is included. Price: $400.

CIRCLE 69 ON FREE INFORMATION CARD

Amplified Speakers

Some people want everyone to hear their personal portable stereos. Your teenager can turn his or her portable stereo into an audio system for use in the bedroom or dorm with the addition of the *SA/40* amplified speakers from *Koss Corporation* (4129 North Port Washington Avenue, Milwaukee, WI 53212). The compact speakers run on four "C" batteries or a 6-volt DC power supply, and deliver impressive amplified stereo sound from portable radios, and CD and cassette players. Dual 3½-inch dynamic drivers produce a full frequency response of 50–20,000 Hz. An internal three-band stereo equalizer allows for individual bass, mid-range, and treble level adjustments. The magnetically shielded speakers can also provide improved sound from portable TV's and computer or video games without data loss or monitor discoloration. Price: $59.99.

CIRCLE 70 ON FREE INFORMATION CARD

Pencil Speakers

If your pockets are deep, and there's someone special on your gift list to whom aesthetics are equally important as high-quality sound, consider making a gift of the *Beolab 8000* bi-amplified floor-standing loudspeaker system from *Bang & Olufsen* (1150 Feehanville Drive, Mount Prospect, IL 60056). Winner of the prestigious "ID: International Design" as well as the "Innovations 92" award, the loudspeaker's design resembles a pencil standing on its point. The cone-shaped lower section rests on a heavy, low-profile base to provide stability. Both the lower section and the tubular cabinet of the upper section are made of a mirror-finished, scratch-resistant aluminum that reflects the rest of the room and allows the speakers to blend in with its surroundings. The slim, rectangular grille is made of matte-black lycra. The speaker is magnetically shielded for use with virtually any audio and/or video system. Its design creates a vertical "window" high enough for both sitting and standing listening positions. The Beolab 8000 is a bass-reflex system that features two four-inch woofers, one ¾-inch ferrofluid tweeter, and two integrated amplifiers (one for bass, the other for treble), for each speaker. Price: $3000 per pair.

CIRCLE 71 ON FREE INFORMATION CARD

For more information on any product in this section, circle the appropriate number on the Free Information Card.

Christmas ELECTRONICS WISH LIST

World's Most Powerful Amplifier

If your grown kids have finally moved out of the house, now they can blast their music as loud as they like, with no complaints from you. If they've moved to a place with no near neighbors, you might want to indulge their taste for volume with the *TFM-75 Dual-Mono Power Amplifier*, which is "the world's most powerful home audio amplifier," according to *Carver Corporation* (20121 48th Avenue West, Lynnwood, WA 98036). It delivers a continuous 750 watts into 8-ohm loads, 1000 watts into 4 ohms, and 1300 continuous RMS watts into a 2-ohm load. The single-chassis, dual-mono design uses separate power supplies and power cords for each channel. Warning: Don't buy this for your upstairs neighbor! Price: $1999.95.

CIRCLE 72 ON FREE INFORMATION CARD

Carver 750-Watt Amplifier

Talking Robot

If your kids are young enough that they'll be at home for quite a few more years, a quieter gift is definitely in order. *2-XL*, the talking robot from *Tiger Electronics Inc.* (980 Woodlands Pkwy., Vernon Hills, IL 60061), might fit the bill, although it's anything but silent (a headphone jack is provided, however). Originally introduced back in the 1970's, 2-XL has been updated for a new generation of children. The robot-shaped toy uses a series of special audio cassettes to provide a wealth of interactive experiences for girls and boys aged 4 through 11. With its unique "personality" and "Noo Yawk" accent, the robot challenges children through fun and entertaining questions, jokes, and stories. 2-XL quizzes kids on topics ranging from sports to space. Children answer multiple-choice, true/false, and yes/no questions by pressing the appropriate buttons on the robot. Mechanical robot sounds and flashing red eyes and mouth add to the lessons. The robot comes with one tape; additional tapes are available separately. Price: $45 (tapes, about $6 each).

CIRCLE 73 ON FREE INFORMATION CARD

2-XL Talking Robot

Creative-Writing Program

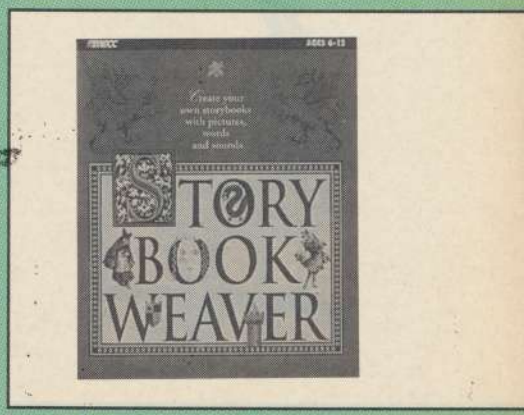
Computer-literate kids can upgrade their writing skills if you make a gift of *Storybook Weaver* from *MECC* (6160 Summit Drive North, Minneapolis, MN 55430-4003). The educational software program, available in Macintosh and MS-DOS versions, helps children (aged 6 through 12) put their imaginations into real stories. It engages kids in the writing process by allowing them to create beautiful pictures and stories to accompany them. Drawing upon the rich collection of folklore from many lands, the software features more than 460 combinations of scenes, over 650 images, more than 48 different colors, and a variety of borders. Younger kids can create picture books with no words, and older children can weave together words and images. Special sound effects and music enhance the stories as they're read on screen, and completed stories can be saved to disk or printed to share with others. Price: $49.95.

CIRCLE 74 ON FREE INFORMATION CARD

Ambidextrous Joystick

The left-handed computer-game player on your list is sure to love the *FX 2000* joystick from *Suncom Technologies* (6400 West Grosse Point Road, Niles, IL 60648). The joystick was designed for use by southpaws as well as right-handed players. With a simple lift of the pistol grip, players can shift the joystick's position to form a perfect line with the arm and wrist, reducing fatigue and allowing hours of comfortable play. The FX 2000 features an ultra-responsive fire button on top, a trigger button that allows lightning fast response, cursor control, throttle control, and suction cups. It can be used on IBM-compatible computers. Price: $39.99.

CIRCLE 75 ON FREE INFORMATION CARD



MECC Creative-Writing Program

Christmas

ELECTRONICS WISH LIST

For more information on any product in this section, circle the appropriate number on the Free Information Card.

Memorex Video Information System

Space Shuttle Video Game

Kids who prefer playing their games on a Nintendo system might like to receive *Space Shuttle Project* from *Absolute Entertainment* (P.O. Box 116, Glen Rock, NJ 07452), which recreates the excitement and drama of space exploration. Hailed by the U.S. Space Camp as "the most realistic space travel home video game ever developed," the game consists of six true-to-life shuttle missions. Players blast off from Cape Canaveral and guide their shuttle into orbit, then undertake daring space walks, satellite launches, repair missions, the construction of a permanent space station, and the rescue of a stranded Russian cosmonaut. Price: $45.

CIRCLE 76 ON FREE INFORMATION CARD

Video Information System

If you'd prefer a system that does more than play games—one that offers something for everyone in the family—consider the *Memorex VIS (Video Information System)*, the latest entry in the interactive-video market, manufactured by Tandy (700 One Tandy Center, Fort Worth, TX 76102) and sold at Radio Shack stores. Targeted for use in the living room, the unit hooks up to the television, which it uses for its display, and plays CD-ROM-based discs that carry the VIS logo. VIS is similar to, but totally incompatible with, its major competitor, Philip's CD-I system. It is compatible, however, with some existing CD-ROM and MPC titles. The system comes with *Compton's Multimedia Encyclopedia*, and a wide selection of entertainment, educational, and game titles are available. Future plans will allow the addition of a modem and keyboard. Price: $700.

CIRCLE 77 ON FREE INFORMATION CARD

After Dark Screen Saver

Full-Motion-Video CD-I

Meanwhile, *Philip Consumer Electronics* (One Philips Drive, P.O. Box 14810, Knoxville, TN 37914-1810) is debuting full-motion, full-screen video for their *Model CDI910 CD-I* player. The addition of a plug-in cartridge for the existing CD-I player provides up to 72 minutes of full-motion video and digital audio. The video quality is about what you'd expect from a VHS tape, but nowhere near as good as a laser disc. Price: About $200.

CIRCLE 78 ON FREE INFORMATION CARD

Fishy Screen Saver

If your idea of full-motion video is watching toasters (and toast) fly across your computer screen, then *After Dark for Windows Version 2.0* should be added to your gift wish list. Although some of the screen displays—fish, moonscapes, and kaleidoscopes along with the toaster—are whimsical, the purpose of the program isn't. It can protect expensive computer monitors from damage caused if a static display is left on for too long a time. It can also prevent snoopy co-workers from reading your screen while you're away from your desk. The sounds included with the program—howling coyotes, bubbles (for the fish)—add yet another touch of humor to it. Price: $49.95.

CIRCLE 79 ON FREE INFORMATION CARD

Back-Up Back Support Sling

Back to Back

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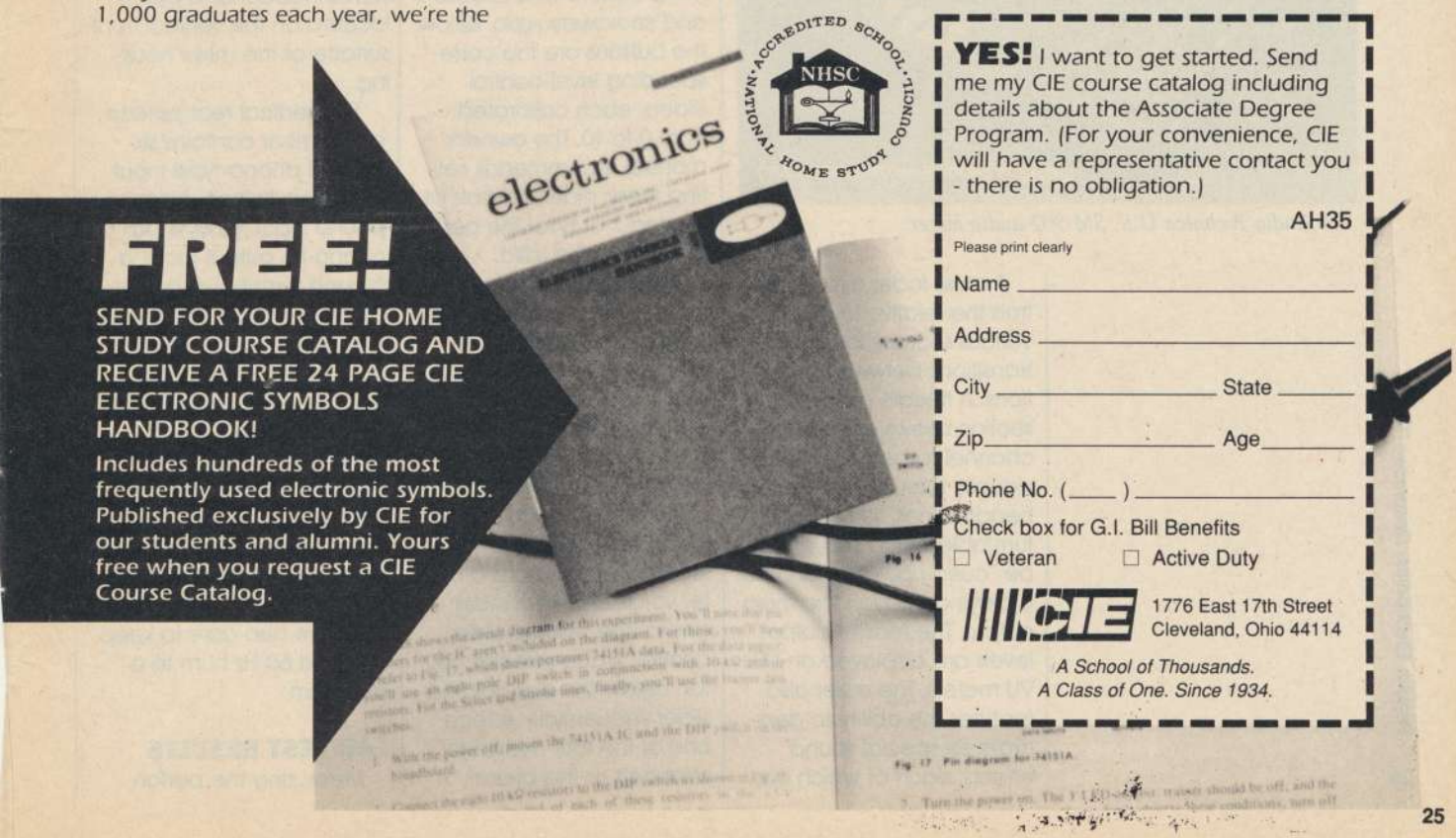

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PRODUCT TEST REPORTS

By Len Feldman

Audio Technica SM-502 Audio Mixer

The Audio Technica U.S. (ATUS) SM-502 stereo mixer provides the serious home-recording enthusiast with much of the flexibility in audio-signal processing that is enjoyed by professional recording engineers operating in commercial recording studios. This little mixer, weighing just over 2½ pounds, accepts signals from two phono turntables, four line-level stereo devices (such as signals from a CD player, a tape deck, a tuner, etc.), and two microphones.

The Audio Technica U.S. SM-502 audio mixer.

A cross-fader circuit controls the relative level of the various sources for smooth transitions between selections. A flexible monitoring section allows any single channel to be heard individually through stereo headphones, so that one turntable or CD player can be "cued up" while another is playing through the main output. The master output levels are displayed on LED VU meters. The mixer also features the ability to generate six special sound effects, each of which can be initiated or triggered at the touch of an appropriate button. The six sounds are described as "snare," "bomb," "video gun," "laser," "phone (ring)," and "UFO." The speed and volume of these six sound effects can be continuously varied.

CONTROL LAYOUT

Along the upper section of the mixer are four two-position pushbuttons. While up to eight program sources can be connected to the mixer at once, only four of these can be controlled and mixed at any one time. Thus, each of the four buttons chooses one of two possible inputs: MIKE 1/PHONO 1, MIKE 2/PHONO 2, AUX/CD-1, and CD-2/CAMERA AUDIO. Below the buttons are the corresponding level-control sliders, each calibrated from 0 to 10. The owner's manual recommends setting these slider controls at around 7 or 8 for the best signal-to-noise ratio.

At the upper right of the panel surface are two rows of LED's used to indicate output levels; these are calibrated in dB from −10 to +4. The +2- and +4-dB LED's for each channel are colored red, indicating the possible approach of overload levels. Just below the level meter LED's are a master volume-control slider and a cue-volume slider control. A cue-selector button below the cue-volume slider sequentially selects one of the four available channels or the overall master-mixed sounds, which can then be listened to via headphones connected to the mixer. The lower left section of the control panel surface is dedicated to the cross-fade feature mentioned earlier. A horizontally oriented slider accomplishes the cross-fade function, while a pair of buttons is used to select the two channels (1 or 3 and 2 or 4) for which the cross fade is to be accomplished. The lower right section of the panel's surface contains the six "sound effects" buttons described earlier, as well as sliders for controlling the speed and volume (intensity) of the selected sound effect. A stereo headphone jack is located on the vertical front surface of the mixer housing.

The vertical rear surface of the mixer contains six pairs of phono-type input jacks, two ¼-inch microphone input jacks, a pair of phono-tip output jacks, a ground terminal, a power on/off switch, and a 12-volt AC input jack into which a plug from the separate (supplied) AC power adaptor is connected. By supplying the AC power adaptor as a separate item, the designers of the mixer were not only able to keep the product slim (it stands only 1.5 inches high), but were also able to keep induced 60-Hz hum to a minimum.

LAB TEST RESULTS

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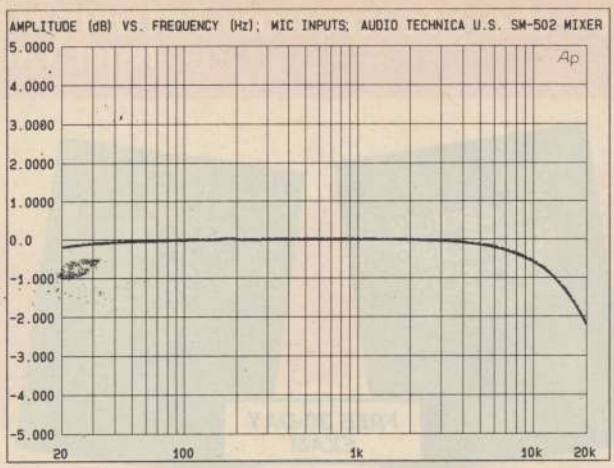
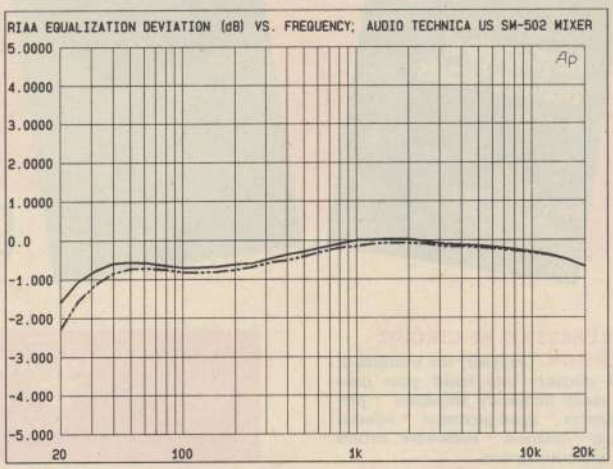
mance of a mixer involves pretty much the same types of measurements as one might make for a preamplifier. First, we measured overall frequency response from input to output with controls set at their nominal (7/8) markings and with nominal levels applied. Response for the high-level inputs was flat down to 20 Hz and was down just over 1 dB at 20 kHz. While the frequency response for either of the two microphone inputs was essentially flat down to 20 Hz, the high-frequency roll-off was a bit greater for these inputs, with readings of just over −2 dB at 20 kHz. Finally, we applied a low-level signal to the phono inputs. That signal was pre-emphasized in accordance with the recognized RIAA equalization curve that is standard for phonograph recordings made in the U.S. If playback equalization were totally accurate, the frequency response should have been perfectly flat. In fact, deviation from perfect RIAA equalization was not very severe, measuring no more than 1 dB or so down to 30 Hz, and about 0.7 dB at 20 kHz.

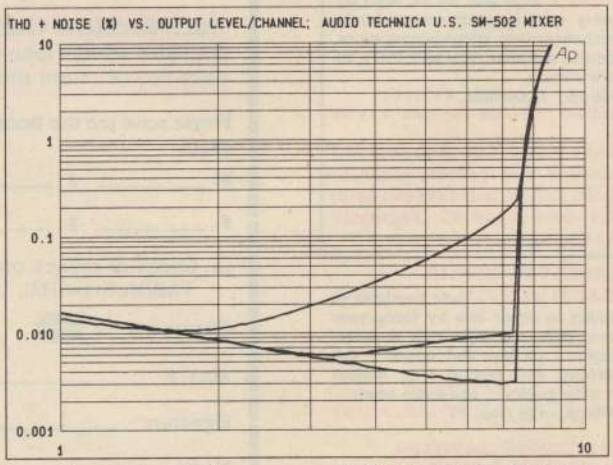
With a nominal 150-millivolt signal applied to the high-level inputs of the ATUS SM-502 mixer, we next measured total-harmonic-distortion-plus-noise versus audio frequency. The THD-plus-noise remained constant over the entire audio-frequency range, with readings of 0.04%; that is slightly better than the 0.05% claimed by Audio Technica in their published specifications. The test was next repeated using the microphone input. With a 1.5-millivolt signal applied, the THD-plus-noise using the microphone inputs was higher than via the high-level inputs, however, our average reading of 0.17% across most of the audio-frequency range was also much lower than the published specification of 0.5%.



While the frequency response using the microphone inputs was essentially flat down to 20 Hz, the high-frequency roll-off was a little higher than seen using the high-level inputs.



While perfect RIAA equalization would have resulted in a flat (at 0-dB) frequency-response curve, the deviation from RIAA equalization shown here is not very severe.



Regardless of the test-frequency used (20 Hz, 1 kHz, 20 kHz), the test signal reached the rated 7.2-volt output level before severe clipping took place (indicated by the sharp rise in distortion).

Audio Technica U.S. lists the maximum output level for this mixer as 7.2 volts. To verify this, we ran a test of harmonic-distortion-plus-noise versus output level for three audio frequencies: 20 Hz, 1 kHz, and 20 kHz. While the distortion tended to rise a bit earlier for the 20-Hz and 20-kHz test signals than it did for the mid-frequency, 1-kHz test signal, all three test-signal outputs reached the claimed 7.2-volt level before severe clipping took place.

Finally, we measured the signal-to-noise ratio of the SM-502 mixer using all three types of inputs available on the product. For line-level inputs, the reference input level was set to 150 mV; the A-weighted signal-to-noise ratio measured 68.6 dB, or fractionally short of the claimed 69 dB. In the case of the phono inputs, the reference input level was set to 3.0 mV; the signal-to-noise ratio measured 67.5 dB as against 62 dB claimed by Audio Technica U.S. Finally, for the microphone inputs, using a reference input signal level of 1.5 mV, the signal-to-noise ratio measured 58.6 dB as against 53 dB claimed by Audio Technica U.S.

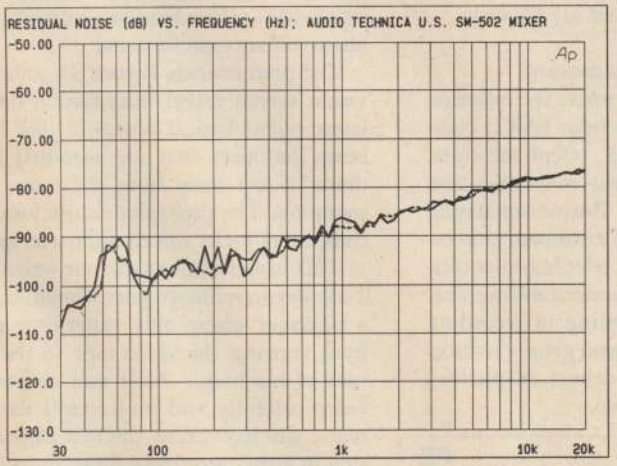
To investigate the nature of the residual noise generated by this mixer, we ran a spectrum analysis of noise-versus-frequency, using a one-third octave filter. The results showed the minimal effect of the power-line frequency (60 Hz). Had Audio Technica U.S. installed the power transformer in the mixer itself, chances are that the 60-Hz hum contributions to the overall noise figure would have been much greater.

HANDS-ON TESTS

We put the SM-502

TEST RESULTS—AUDIO TECHNICA U.S. MS-502 MIXER

Specification	Manufacturer's Claim	PE Measured
Frequency response		
Microcphone	20 Hz–20 kHz ±3 dB	±2 dB
High-level inputs	20 Hz–20 kHz ±3 dB	±2 dB
Mag. phono	30 Hz–20 kHz ±1 dB	Confirmed
Input sensitivity		
Microphone	1.5 mV	Reference
High-level inputs	150 mV	Reference
Mag. phono (1 kHz)	3.0 mV	Reference
Output levels		
Normal	1 volt	Confirmed
Maximum @ clipping	7.2 volts	7.3 volts
Total harmonic distortion		
Microphone	0.5%	0.17%
High-level inputs	0.05%	0.04%
Mag. phono	0.2%	Confirmed
Stereo crosstalk		
High-level input	Better than 66 dB	Confirmed
Mag. phono & phones	Better than 60 dB	Confirmed
Signal-to-noise ratio		
Microphone	53 dB	58.6 dB
High-level inputs	69 dB	68.6 dB
Mag. phono	62 dB	67.5 dB
Phones output level	5 mW/4 ohms	Confirmed
	16 mW/16 ohms	Confirmed
	24 mW/24 ohms	Confirmed
Dimensions (W×H×D, inches)	13×1.5×7.5	Confirmed
Net weight	2.53 lbs.	
Suggested price:	$239.95	



A spectrum analysis of the residual noise revealed that 60-Hz power-line hum played a relatively negligible part. That is due to the use of a separate plug-in power supply.

through its paces, using it for a wide variety of mixing chores, including adding narration (via the mic inputs) to previously recorded tapes in our collection. The mixer is easy to hook up and even easier to use. We especially liked the cross-fade feature that allowed us to smoothly fade from one program source to another. This feature should appeal to amateur or professional disc jockeys.

For more information on the SM-502 Audio Mixer, contact Audio Technica U.S. (1221 Commerce Drive, Stow, OH 4224) directly, or circle No. 119 on the Free Information Card. ■

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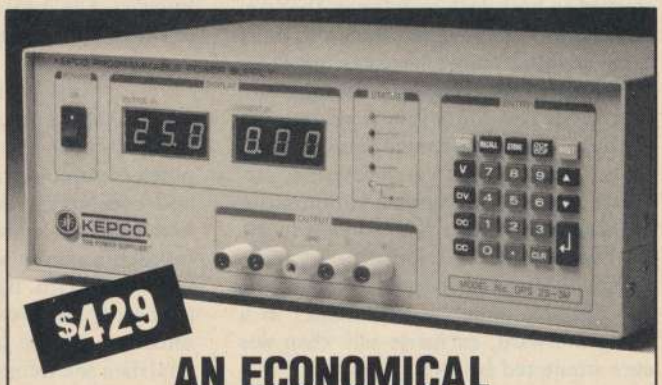

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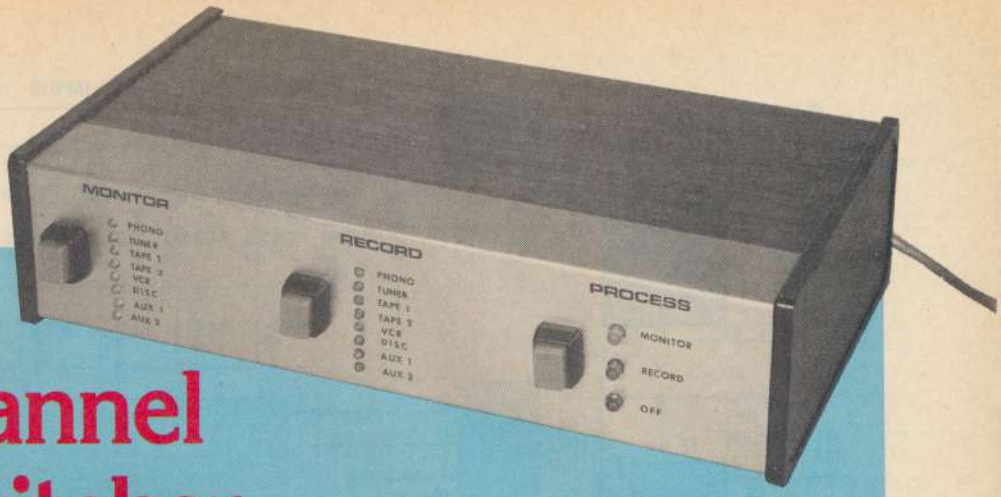


Build an Eight-Channel Audio Switcher

BY TIM GOEBEL

Give your present A/V system something that the audio-component manufacturers seem to have overlooked—more audio inputs

The home-entertainment revolution of the past few years has meant a big improvement in the selection of what we can listen to and watch in the comfort of our own homes. Hi-fi videotapes, stereo television, surround sound, laser discs, CD's, cassette decks, radio tuners, and record players or turntables (yes, some people still have and use them) have added up to a number of audio choices that were never even dreamed of 20 years ago.

In fact, until just recently, most manufacturers of receivers and amplifiers didn't seem to notice the changes. They kept designing and manufacturing audio equipment with just one or two inputs for auxiliary equipment, and we consumers kept buying them. But now, as we play "catch up with the Jones'," adding another piece of equipment here and there, we're finding that our amplifiers and receivers just can't handle all the choices.

Although you could rush right out and get new equipment to handle the problem, that often isn't the most practical solution, especially when there's nothing else wrong with the old stuff. That's where the *Eight-Channel Audio Switcher* described in this article comes in. The switcher allows you to choose between eight-different, stereo-audio sources, and feed the selected signal to one pair of stereo inputs on your current receiver or amplifier, freeing up any additional inputs that might be present on the unit.

The Heart of the Matter. At the heart of the audio switcher is an LM1037, a dual low-noise, four-channel analog switch. That chip is designed to switch between 4 different stereo audio sources (A, B, C, and D). Figure 1 shows a pinout diagram of the LM1037, which, as you can see, has eight input pins (for four stereo sources) and two pins for the stereo output.

Four pins on the LM1037 (16, 18, 1, and 3) control which stereo input is transferred to the output. The desired input is selected by placing a high (+V) on the appropriate control pin. For example, to listen to source A, 12 volts would be placed on pin 16, the A-channel input selector. Any audio source connected to pins 2 and 4 (the A-channel input terminals) would be transferred to the chip's stereo output at pins 9 and 10. All other input control pins are kept low (at ground) until they are selected.

If no inputs are selected and pin 7 (mute) is held low, the output is disabled. That feature allows the outputs of several LM1037's to be connected in parallel to increase the number of available inputs. In this project, two LM1037's are used to provide 8 stereo inputs. Alternately, if pin 7 is left disconnected and no inputs are selected, a monophonic audio input at pin 12 (the optional common input/bias) will be switched to both output pins. That last option could prove useful for a paging system, but is not used in this project.

About The Circuit. Figure 2 shows a complete schematic diagram of the Eight-Channel Audio Switch. Source selection is accomplished by pressing momentary-contact pushbutton switch S1. Switch S1 is connected to the trigger of a 555 oscillator/timer (U1) that's configured as a monostable multivibrator, which generates one short output pulse for each press of S1. That pulse turns on LED1 to give a visible indication that the 555 is working correctly. That pulse is also used to clock U2 (a 4017 CMOS divide-by-10 counter/divider).

Both LED1 and its associated current-limiting resistor R3 are optional,

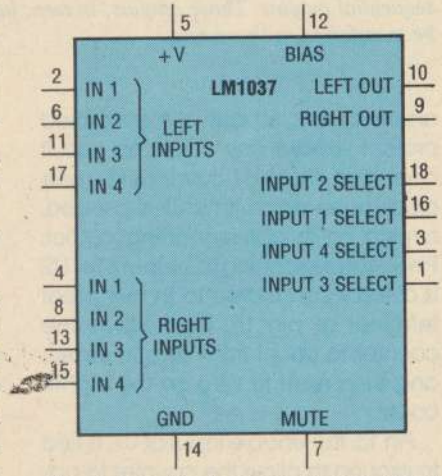


Fig. 1. This block pinout diagram shows that the LM1037 has eight input pins (for four stereo sources) and two pins for the stereo output. Four pins on that chip (16, 18; 1, and 3) are used to select which stereo input is transferred to the output.

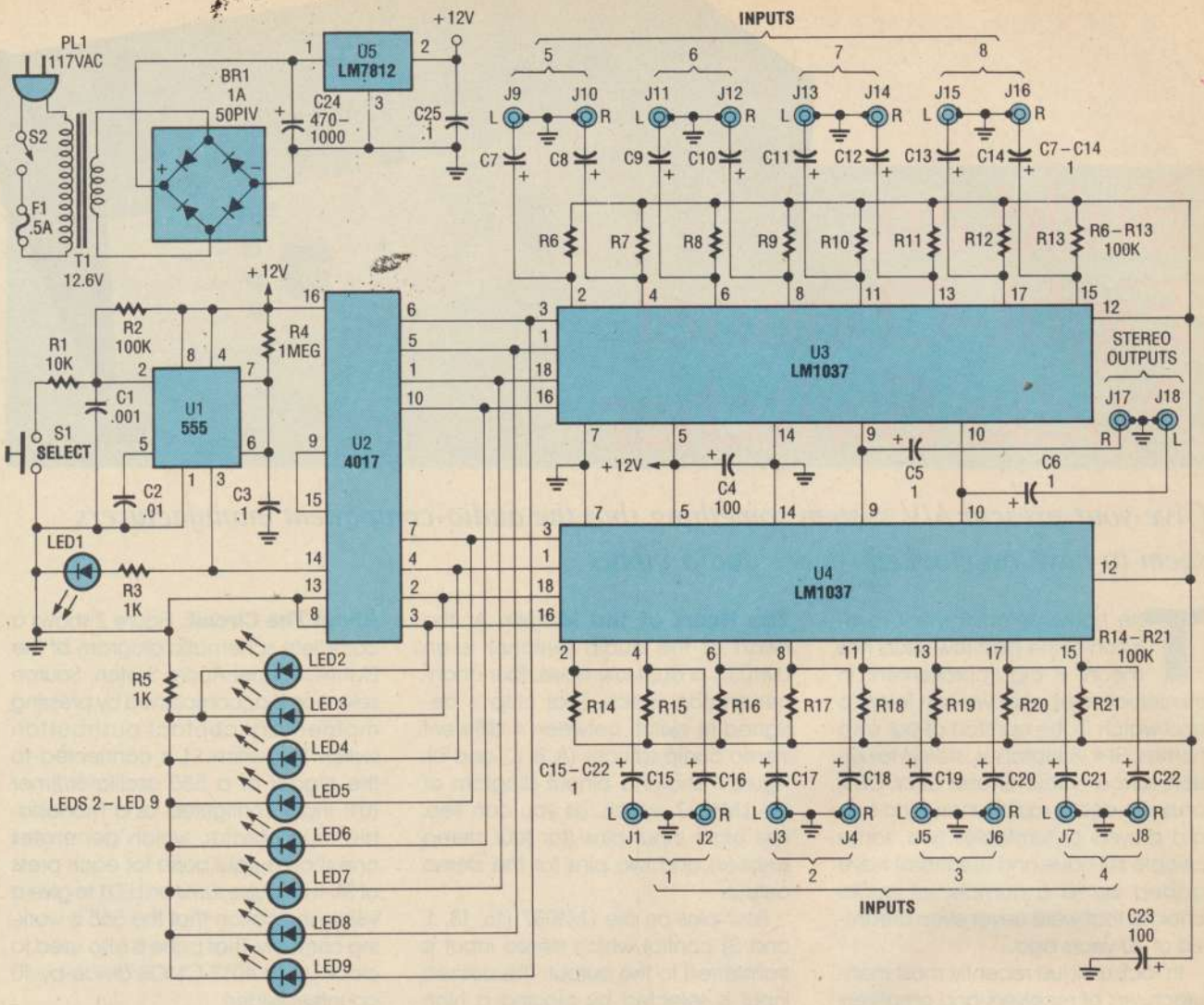


Fig. 2. Input-source selection is accomplished by pressing S1; a single output pulse 15 produced by U1 for each press of S1. That pulse is used by U2 to activate one of its ten sequential outputs. Those outputs, in turn, inform U3 and U4 which input source is to be transferred to the output.

and may be left out of the finished project without any affect on circuit operation. The 4017 advances by one clock pulse each time S1 is pressed, turning on its corresponding output. Pin 9 (corresponding to output 8) of U2 is directly connected to its own reset terminal at pin 15. That allows the counter to count from zero to seven, and then reset to zero on the eighth count.

Pin 13, the enable input of U2, is tied to ground to allow the counter to operate. Outputs zero through seven are connected to eight indicator LED's and the control pins of the two LM1037's (U3 and U4). When an output is selected, its LED lights and the corresponding control input on the LM1037 is brought high. To illustrate what is happening, assume that pin 3 of U2 is high. LED2 lights and pin 16 of U4 (the channel 1 enable) is brought high. Integrated circuit U4 then switches the audio signals applied to pin 2 and pin 4 to the IC's outputs at pins 9 and 10.

Since none of U3's control pins are high and pin 7 is grounded, U3's outputs are disabled, and only the selected audio signal from U4 appears at the left and right outputs (J17 and J18). Pin 12 (bias) of both LM1037's are tied together and connected to ground via C3, a 100-μF capacitor, to prevent switching thumps when going from the output of one LM1037 to another.

The LM1037 has extremely high-impedance inputs and low-impedance outputs, so interconnection between various types and brands of equipment should not be a problem. That, together with a wide-frequency response and low distortion, makes it deal for use with good-quality, home-entertainment systems. The prototype of the audio switcher has a usable frequency response of from just a few hertz to over 100 kHz.

Power for the switcher is provided by a rather simple circuit (see Fig. 2). Since the switcher only draws between 20 and 30 milliamps, a simple circuit using the popular 7812 or 78L12 (a low power version) voltage regulator works quite well.

Construction. A printed-circuit pat-

tern for the Eight-Channel Audio Switcher is shown in Fig. 3. The circuit board is a little larger than necessary for the simple circuitry of the project, but that allows plenty of maneuvering room for soldering and drilling mounting holes. Unfortunately, due to space limitations, that also means that the pattern must be shown here at half size.

Figure 4 shows a parts-placement diagram for the Eight-Channel Audio Switcher. Note that the printed-circuit board doesn't contain any of the power-supply circuitry. Instead, it was hard-wired together within the switcher's enclosure, and connected to the printed-circuit board at the appropriate points.

Begin assembly by installing sockets for the four IC's, but do not install the IC's in their sockets until the circuit is completely assembled and checked for errors. Although the use of sockets makes the project a little more expensive, they can also save hours of grief later when trying to remove and replace defective chips. Jumpers and resistors can be installed next, followed by the capacitors, taking note of the polarization of the electrolytic and tantalum units.

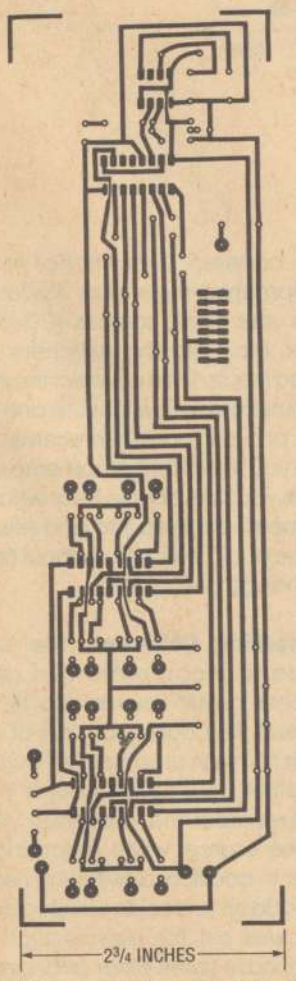


Fig. 3. Here is a half-size printed-circuit pattern for the switcher. The circuit board is a little larger than necessary for the simple circuitry of the project, but that allows plenty of maneuvering room for soldering and drilling mounting holes.

PARTS LIST FOR THE EIGHT-CHANNEL AUDIO SWITCHER

SEMICONDUCTORS

U1—555 oscillator/timer, integrated circuit
U2—4017 decade counter/divider, integrated circuit
U3, U4—LM1037N four-channel analog-switch, integrated circuit
U5—7812 (1-amp) or 78L12 (100-mA) 12-volt, voltage regulator, integrated circuit
BR1—1-amp, 50-PIV, fullwave-bridge rectifier
LED1–LED9—Light-emitting diode

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1—10,000-ohm
R2, R6–R21—100,000-ohm
R3, R5—1000-ohm
R4—1-megohm

CAPACITORS

C1—0.001-μF, ceramic-disc
C2—0.01-μF, ceramic-disc
C3, C25—0.1-μF, ceramic disc
C4, C23—100-μF, 35-WVDC, electrolytic
C5–C22—1-μF, 35-WVDC, tantalum or metal-film
C24—1000-μF, electrolytic

ADDITIONAL PARTS AND MATERIALS

F1—0.5-amp fuse
T1—12.6-volt stepdown transformer
S1—SPST momentary pushbutton switch
S2—SPST toggle switch
PL1—Molded 117-volt AC power plug with line cord
J1–J18—RCA jack
Printed-circuit materials, enclosure, IC sockets, fuse holder, wire, solder, hardware, etc.

Once all of the on-board components have been installed, place the circuit board to the side and prepare the enclosure that will house the circuit board and off-board components. Remember that the enclosure should have ample room for the circuit board, off-board power supply, and the other off-board components. Drill nine holes in the front panel of the enclosure for the LED's and 2 for the switches. On the rear panel, drill 18 holes for the input/output jacks (J1–J18), and another for the power cord.

Install all of the off-board components in their respective mounting holes and secure in place. In the case of the LED's, they can be secured in place with silicon cement. Begin wiring the off-board components (switches, LED's, jacks, etc.) to the circuit board. Although single-conductor hookup wire can be used for connections between the input and output jacks if a metal project box is used, shielded cable will provide better isolation (less crosstalk between sources) between the audio channels. When wiring this portion of the project, it is recommended that you carefully mark or color-code the cables and then solder them in place.

The final step is to wire the LED's to the circuit board. There are 8 separate anode lines for those LED's, corresponding to the 8 input channels. One output serves as a common cathode for all 8 LED's in your finished project; simply label the LED's as required. For example, LED2 (input 1) could be tuner. LED3 (input 2) could be CD player, etc.

Once all of the parts have been installed and the off-board components are wired to the circuit board, check your work for the usual construction errors. When you are satisfied that the circuit contains no construction errors, it's time for the smoke test.

Set-Up and Use. Very little has to be done to set-up the switcher, since there is nothing to adjust. As long as everything has been soldered in the right place, it should work as soon as it is connected in your A/V system.

One possible problem that might crop up can be traced to the action of the 4017. The 4017 has a tendency to allow more than one of its outputs to be on at power-up. If that happens, 2 or more LED's will light. To correct that situation, simply press S1 several times to select whichever source you would like to listen to. To avoid the problem, just leave the power to the switcher on.

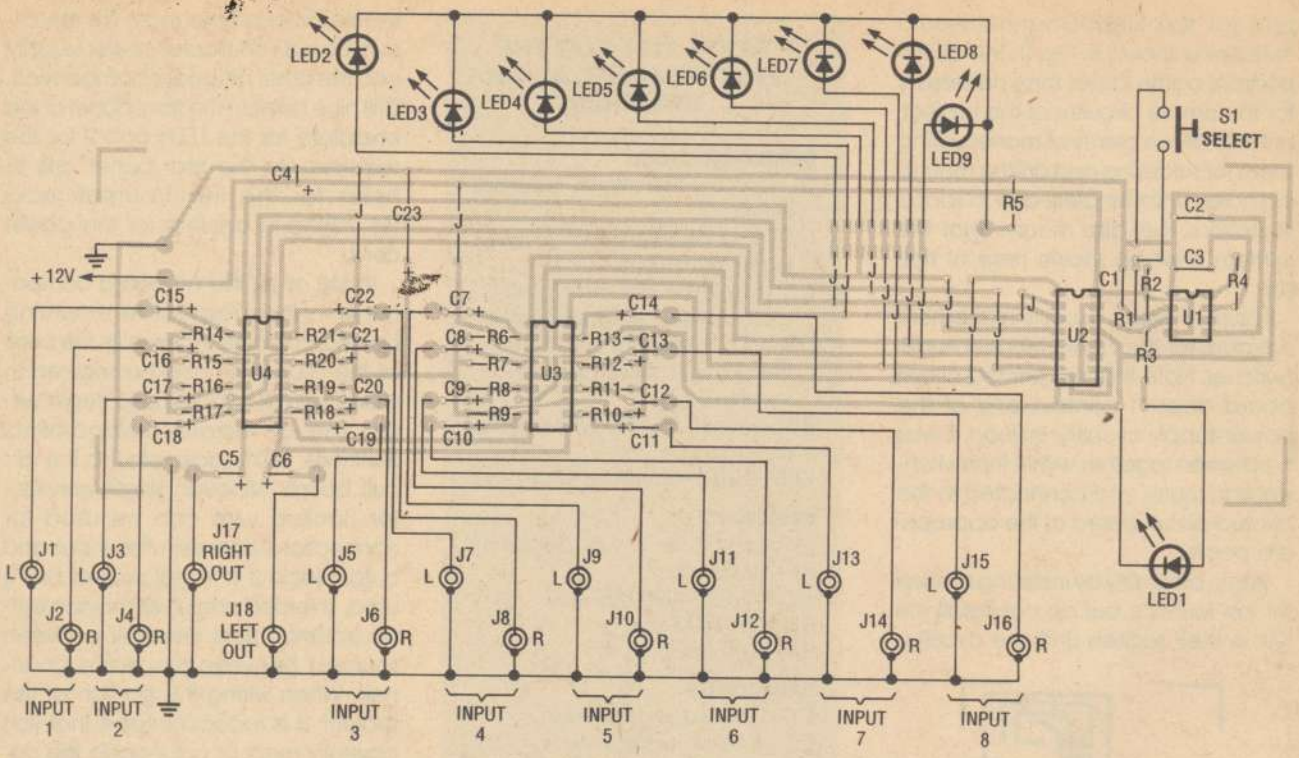
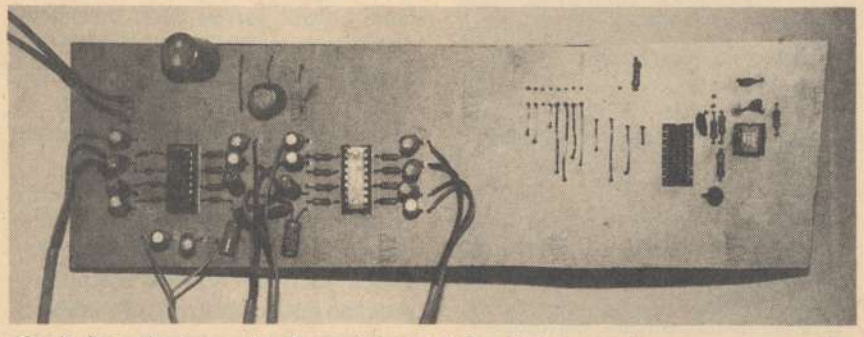
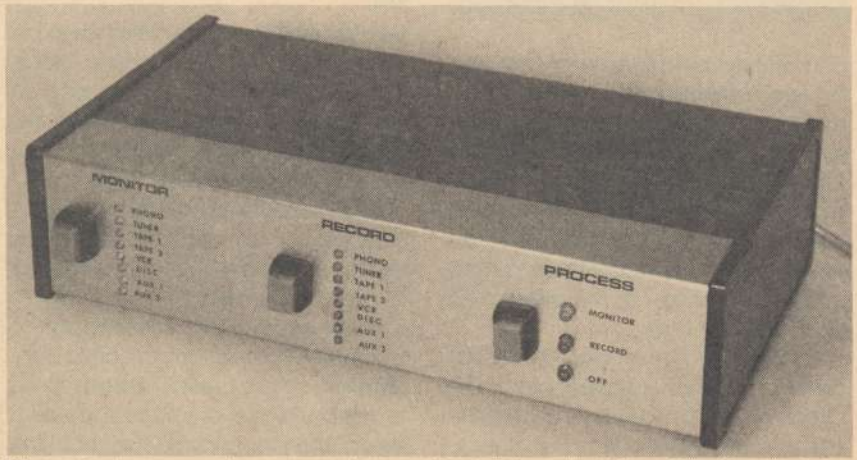


Fig. 4. Note that this parts-placement diagram for the Eight-Channel Audio Switcher doesn't show any of the power-supply circuitry. The power supply was, instead, hard-wired together within the switcher's enclosure, and connected to the printed-circuit board at the appropriate points.



Here's the author's populated circuit board. It is a little larger than necessary to make assembly easier.

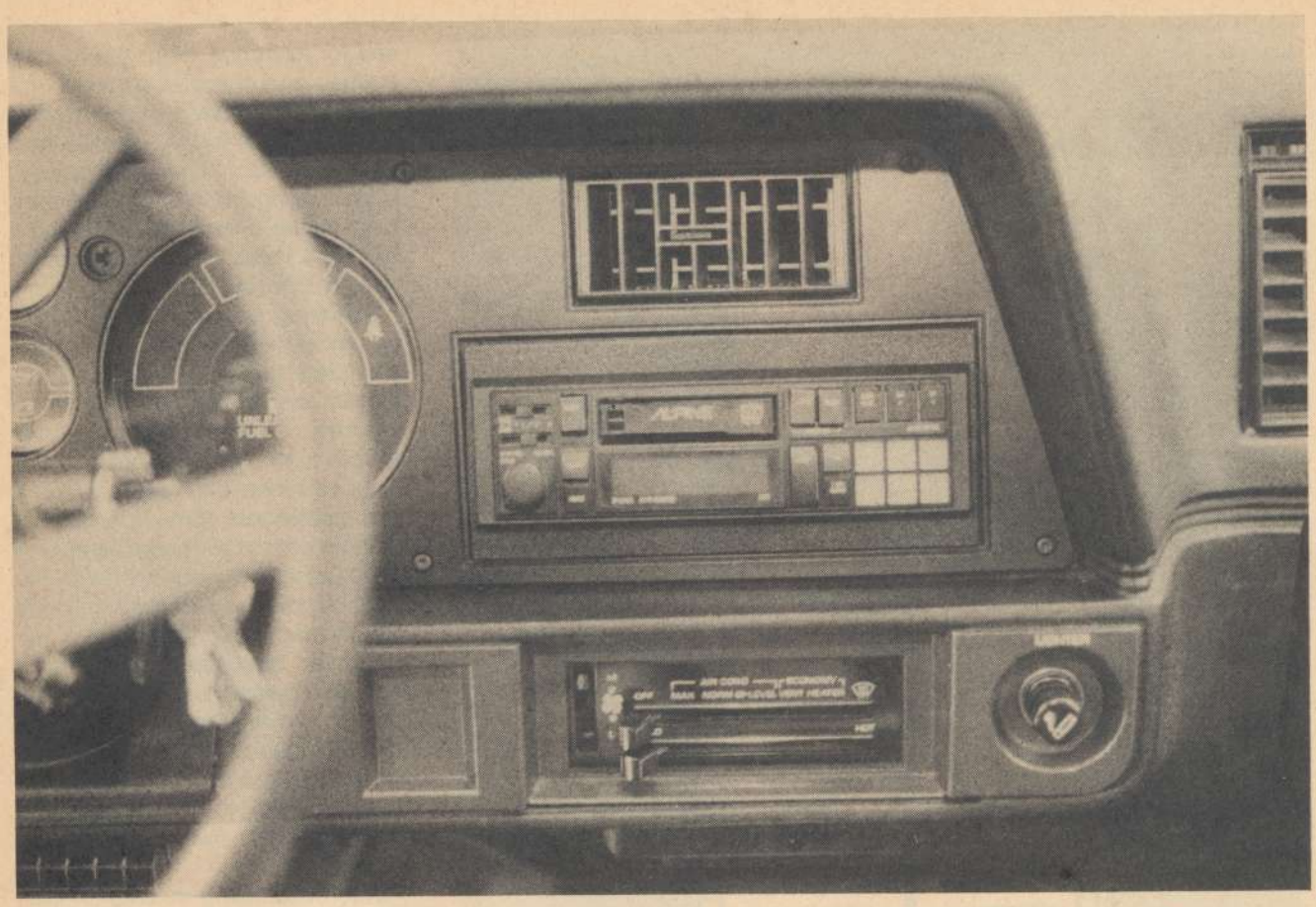


The author's prototype incorporated two audio-switcher circuit boards and a switching network.

To connect the switcher to your equipment, simply plug the outputs from your audio sources (CD player, tuner, etc.) into the switcher's eight stereo inputs. Then connect the stereo outputs from the switcher to one input pair on your amplifier/receiver. Anytime you select that amplifier/receiver input, you'll be able to hear whatever has been plugged into and selected on the audio switcher... without having to change one cable!

Something Different. The author chose to incorporate two audio-switcher circuit boards into his final product. The output of one of them feeds his main amplifier. The output of the other goes to the input of a cassette recorder. That allows him to listen to one source, while recording another. In addition, a switching network was added to decide which output, if any, was set for equalization. You might have some other arrangement in mind.

However you decide to modify the circuit, it should give you many years and countless hours of listening pleasure. ■



Installing and Troubleshooting Car-Audio Systems

These valuable hints and techniques can help you install a car-stereo system like a pro.

BY WAYNE R. GIPSON, CET

Like most worthwhile endeavors, installing your own car-stereo system is much easier if a few professional methods are utilized. Furthermore, armed with the right knowledge, installing a car stereo can also be a rewarding experience. To help you "roll your own" set up, this article will provide insights into practical installation and troubleshooting techniques. This article will also help you determine if a particular system or vehicle might demand professional installation, and will provide "red flags" that might help the installer avoid damage to the vehicle or stereo.

It should be mentioned that the procedures set forth here are not to be interpreted as applying to every installation scenario. The reader is expected to use his or her own judgment in applying these ideas to their own situation. Always read and follow the instructions supplied with your stereo system. If questions arise, consult the dealer from whom the equipment was purchased.

Sizing-Up the Job. Many problems arise when trying to fit a car stereo into a vehicle that cannot accommodate the system's size or dimensions. Some stereo systems are simply too large to be mounted into the dash of a smaller vehicle, and speakers that are too large for the cavity of the interior of the car can be damaged in use. To avoid these problems, take advantage of the literature that your dealer can provide that will list dimensions of the different head units and speakers that you are considering. Be sure to take advantage of all the good advice that a knowledgeable dealer might offer. If you buy your equipment from such a dealer, he will be glad to evaluate your vehicle. After all, it is much easier, and more profitable, for

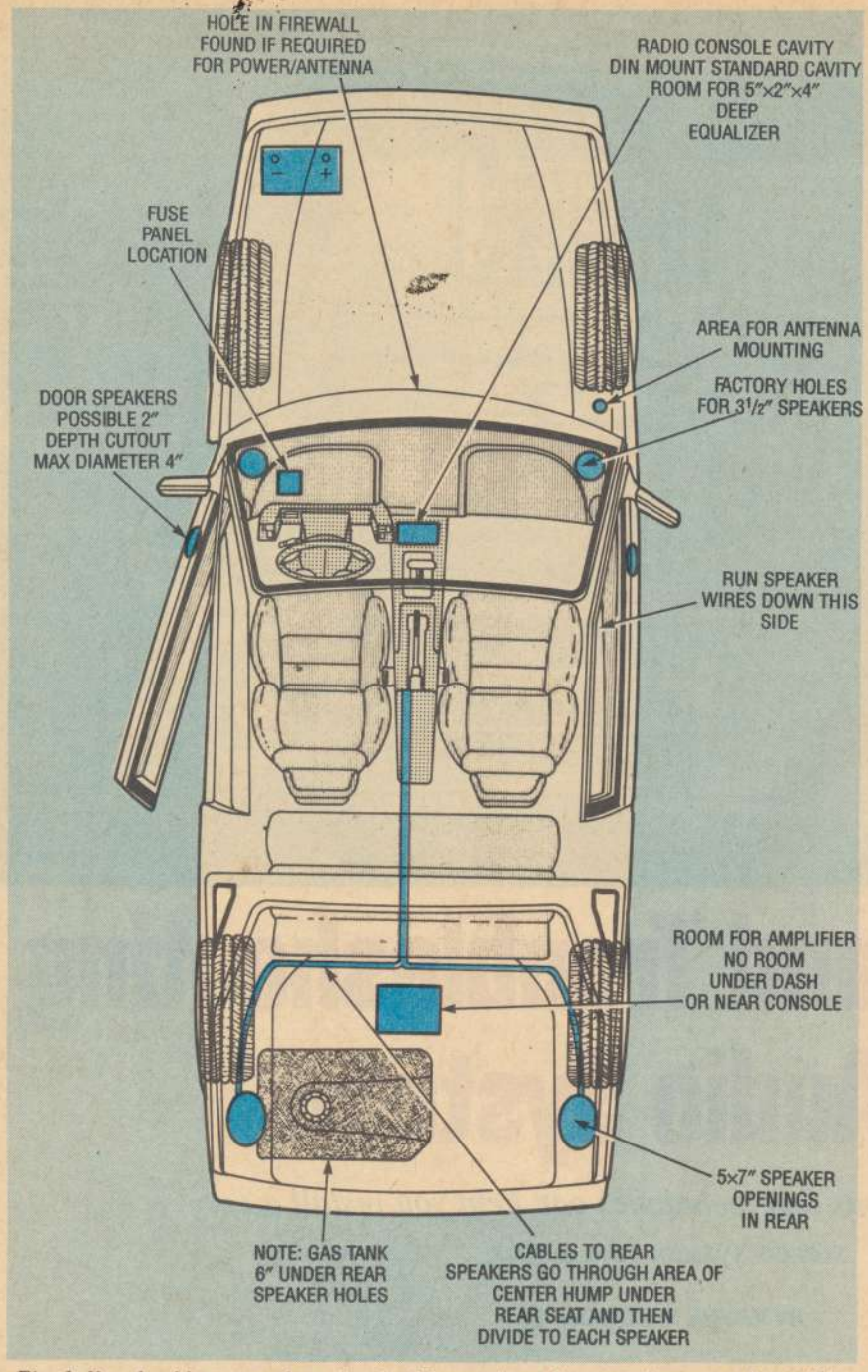

HOLE IN FIREWALL FOUND IF REQUIRED FOR POWER/ANTENNA
RADIO CONSOLE CAVITY DIN MOUNT STANDARD CAVITY ROOM FOR 5"×2"×4" DEEP EQUALIZER
FUSE PANEL LOCATION
AREA FOR ANTENNA MOUNTING
FACTORY HOLES FOR 3½" SPEAKERS
DOOR SPEAKERS POSSIBLE 2" DEPTH CUTOUT MAX DIAMETER 4"
RUN SPEAKER WIRES DOWN THIS SIDE
ROOM FOR AMPLIFIER NO ROOM UNDER DASH OR NEAR CONSOLE
5×7" SPEAKER OPENINGS IN REAR
NOTE: GAS TANK 6" UNDER REAR SPEAKER HOLES
CABLES TO REAR SPEAKERS GO THROUGH AREA OF CENTER HUMP UNDER REAR SEAT AND THEN DIVIDE TO EACH SPEAKER

Fig. 1. You should try to make a sketch of the pertinent features of your car. It needn't be as graphically detailed as this one, but it should contain the same kinds of information.

him to to satisfy your needs at the onset, rather than have to take back merchandise that cannot be made to fit. By the same reasoning, be wary of a salesman who pushes a particular stereo before he even knows what type of car or truck you own.

The first step in deciding on the right stereo is to draw a diagram of your vehicle on a piece of graph paper, similar to that shown in Fig. 1. Take time to visualize what you want your system to look and sound like before you buy it. Once features have been settled on, price must be considered. At this point, before shopping seriously, consider the list shown in Table 1 to determine if there are any accessories that must be included in your price.

Having a firm grasp on wanted features and price, examine the dash area of the vehicle. Most older domestic cars have a "two-shaft" radio (one shaft for the volume control and one for tuning). If, when the radio is pulled, and there is a small rectangular center cavity with shaft holes on either side, you are limited to a shaft-type radio. If there remains just a large rectangular cavity, then you can install either a shaft-type radio or a DIN type radio, depending on the mounting bracket you buy.

Speaking of mounting brackets, several car-stereo accessory manufacturers market a wide range of plastic faceplates and mounting brackets custom designed for your vehicle type. These accessories can make your installation look very sharp and professional. Some can accommodate both a DIN-mount stereo and an equalizer in the cavity used by the original radio. Generic mounting units are also available, and they are usually much cheaper than the ones marketed by the car-stereo manufacturers. However, to take advantage of special mounting arrangements like the radio/equalizer mounting mentioned above, the manufacturer's mounting units must generally be used.

When examining installation literature put out by the manufacturers, be wary if the guide states "professional installation recommended" or warns you that the system is incompatible with your vehicle. Take their advice, and do not attempt to install such a model in your car. Always remember the manufacturer is eager to sell equipment. If they gave-up trying to fit the unit into your model of vehicle, you stand a very slim chance of proving them wrong.

If your vehicle has a 24-volt electrical system or a "positive ground" (meaning the positive post of the battery is connected to the chassis, or frame, of the vehicle), do not attempt installation yourself. Take your vehicle to a professional installer. Damage to the stereo and vehicle will surely result from improper installation in such a situation.

If you own a newer vehicle, seek advice before replacing a factory-installed/original-equipment stereo unit. Some new vehicles have sophisticated wiring and control schemes that are designed specifically for that car maker's factory-installed stereos, and careless or incorrect removal of the radio might cause damage to the vehicle's electrical system.

Getting to It. One tip that will save you a great deal of time is to test the system outside of the vehicle before installation. That gives you a chance to rehearse the installation before the fact. It is very discouraging to put the vehicle back together, button everything up, and turn on the unit only to learn that it is an "out of box" failure. Those instances, happily, are few and far between, but it is good practice to do a bench test; if the unit is bad, it is much easier to return a like-new unit versus one whose chassis has been scarred and fingerprinted during the installation process. If you'd like, the retailer that sold the unit may bench test it for you.

Before starting to remove the old stereo or installing the new unit, disconnect the negative battery cable from it's terminal. That prevents the battery from running down while the doors, trunk, and hood are open, and also prevents injury to you should you accidentally short the wiring.

Carefully examine the original radio to learn how it comes out of the vehicle. If it is a shaft-mount unit, generally there are nuts affixing the control shafts to the dash, and then there will be a back brace that holds the rear of the radio tight to the car's frame. Basic mechanic's tools are sufficient to accomplish the removal; use deep sockets to loosen the front nuts. On some vehicles, the radio is mounted from the front, and generally the bolts that fasten the radio to the console can be easily taken out, although a few utilize reverse-headed bolts that require a special tool available from an auto-parts store or from the dealer to be removed.

Once the radio is unfastened, carefully detach the wiring from the radio. Some of the connectors can be incredibly hard to remove, but generally they will detach without much trouble if time is taken to examine the fasteners and find any "hidden" snaps or brackets used to keep the cables in place. Never cut any of these connectors off. As we'll discuss shortly, these connectors might be able to attach to an aftermarket harness interface, or if the original radio was to be replaced, perhaps when the vehicle is to be traded, they would be handy if left in place. When those connectors are disconnected from the radio, pay attention to where the power cables are. These must be taped up so they do not touch anything or short together.

Follow the car-stereo manufacturer's instructions to physically install your new unit. One installation step many inexperienced installers overlook is to secure the back strapping (shown in Fig. 2). In order to ensure a trouble-free installation, the stereo must be secured with that strap. The pressure on the front shafts and nose piece of the stereo is relieved by the back strap, keeping problems like broken printed-circuit boards and bound mechanisms to a minimum. The metal back strap also provides a common ground for the system. To help avoid noise and engine interference problems (which we'll explain later), a good ground point is essential.

Generally, it is best to avoid hooking up a stereo to *any* of the wiring harnesses that are provided by the vehicle manufacturer unless an aftermarket "breakout" harness is used to plug into the original harness. Such breakout units will clearly label wiring that can be used in installing the new stereo. If no such harness is available, run your own cabling *directly* to the speakers, power source, etc. It is dangerous to take for granted that a wire emerging from the vehicle's wiring harness reading +12 volts will be correct for hooking up to your stereo. The voltage might be coming from an electronic control point to the clock or tuner memory, and drawing current sufficient to power your stereo will damage the source. You might consider using the cable that powered the original radio, but the size of the wire could be insufficient to feed the new system, particularly if amplifiers or other peripherals are installed. The wire might overheat, and burn up the vehicle's wiring harness, or it might be connected to a fuse that will blow when the system is cranked up, disabling other equipment in the vehicle.

One tip to help you get the connectors you may need for your radio would be to bring the literature supplied with your new equipment to the dealer. That way he can "see" what you want, rather than trying to figure out what to sell you from a verbal description.

Antennas and Accessories. Most units today have one power wire to power the amplifier section and control functions, and another to provide a continuous voltage to retain selected stations in memory and to power the clock function. The main power wire allows the radio to be turned on and off with the ignition switch. Sometimes the second wire, if deprived of 12 volts, will prevent the radio from working. This wire must be connected to a source that provides 12 volts on a continuous basis.

If you have an electric antenna in your existing system, provisions must be made to provide power to the antenna. Generally, when 12 volts is applied to the antenna's power-lead, the antenna extends, and when the 12 volts is removed, the antenna retracts. There are a few variations, so consult the dealer if in doubt. The antenna power lead can often be determined by examining the original radio. Sometimes, a wire legend is stamped on the radio with the abbre-

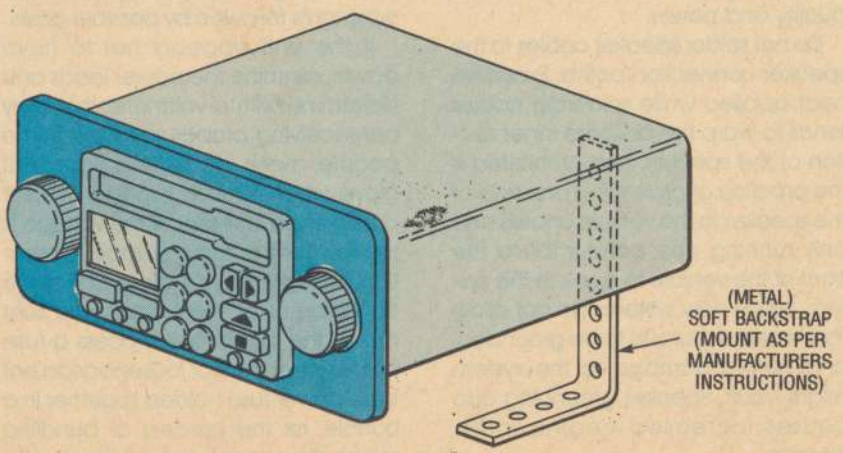


Fig. 2. Don't forget to use the metal backstrap in your installation. It provides a secure mechanical and ground connection for your head unit.

viation "ANT" denoting the antenna wire, or one of the wires might have a tape affixed to it labeled as an antenna lead. Most car stereos have a 12-volt outlet wire that is used to supply voltage to the antenna when the radio is powered up.

Keep all connecting cables as short as possible between the radio (or head unit) and any add-on components, such as an amplifier or equalizer. If a long run is necessary (perhaps because the amplifier is mounted in the trunk), then use quality interconnect cable to minimize interference. Be sure to follow the manufacturer's instructions regarding size of power cables for the amplifier. Most of the time, you can connect amplifiers and head units of different manufacturers together, but be sure to find out if special interconnections are required. Once again, your equipment's documentation will help the dealer determine how and what accessories are required to complete the installation. When mounting amplifiers and other items, such as crossovers, really beautiful bases can be made for these accessories by using finished plywood. A plywood base is great for mounting a system's amplifiers and crossovers behind the seat in a pickup, or in the trunk of a car.

Speaker Tips. Data on selecting correct speaker sizes can be had in the same manuals that the manufacturers publish for their head unit recommendations. The speakers must seal the opening they project sound through. You must not let air escape around the speaker mounting from the front of the cone back to the rear. Such leakage will diminish sound quality and power.

Do not solder speaker cables to the speaker connection points. Excessive heat applied while soldering cables tends to warp the delicate inner section of the speaker. Also prohibited is the practice of grounding one side of the speaker to the vehicle chassis and only running one conductor to the front of the vehicle to hook to the system. Many new systems do not allow their speaker outputs to be grounded, and serious damage to the system might result. Speaker grounding also causes increased engine interference.

There is always considerable attention paid to the size of the conductors going to the speakers. In general, larger cables are favored. As a rule, 16-gauge wire is considered the minimum in a good sound installation. Also, always use stranded cable. In running speaker, interconnnecting cable, and power leads, professional installations employ a product called "split loom." This is plastic sheathing that slips over cable bundles, protecting and organizing the installation.

When putting speakers in doors, it is often very difficult to take the plastic covers off the doors without breaking the white compression fasteners that hold the plastic covering to the metal door frame. There is a tool available that looks like a pronged screwdriver. This tool can be used to apply leverage to those fasteners, and remove them without breaking. If the vehicle has dash-mount speakers, a "must have" tool is a 90°-offset screwdriver.

TABLE 1—COST ANALYSIS

Stereo System	
Head unit	$ _____
Speakers:	
Front pair	$ _____
Rear pair	$ _____
"Add-on" tweeters, etc.	$ _____
Accessories	
Premium speaker cable	$ _____
Add on amplifier(s)	$ _____
Add on equalizer	$ _____
Fader control	$ _____
Head unit mounting shell	$ _____
Interconnect cables	$ _____
Speaker mounting adapters	$ _____
Total materials	$ _____

Troubleshooting. The remainder of this article will be devoted to troubleshooting. This part is organized into symptoms followed by possible cures.

If the unit appears not to have power, examine the power leads and determine with a voltmeter that they are receiving proper voltages. Some people make do with a light that glows when 12 volts is present, but if possible use a meter; if the voltage is too low for the radio's proper operation, the light may still glow. Check the condition of all the fuses. Make sure that in the installation process a fuse holder is not bent or loosened (do not tape power fuse holders together in a bundle, as the process of bundling might disconnect one of them). Use an ohmmeter to ascertain whether the fuses are good. Just looking might not catch an open fuse. If a fuse is violently blown, check the wiring for shorts or incorrect connections.

There are a few things you can do if the unit lights up and the cassette motor (if applicable) works, but there's no sound from the speakers. If no amplifier or equalizer is present, check the wiring harness to make sure it stayed together. Sometimes they are hard to mate up, and might not be pushed together tightly enough to achieve contact. If an amplifier or other accessories are present, be sure that they are getting power and are properly wired together. Sometimes, the amplifier requires a sensing voltage to power-up. This is generally obtained by attaching the sensing wire to the antenna's 12-volt lead (from the head unit or receiver).

Believe it or not, if the power is on but a speaker is dead, many times this is just a problem with the balance control set in one direction during installation. If that isn't the case, check for a bad speaker-cable connection or a defective speaker. If the system has a power amplifier, also check for a bad connection from the head unit to the amplifier.

Sometimes there may be sound on both sides, but when the balance is in the center the volume decreases. The problem in this case is that the speakers are out of phase. That can easily be corrected by switching the two conductors on one speaker.

In some situations the tape deck works, but there's no signal from the AM or FM sections. If you have prechecked the unit before installation, and the radio worked at that time, the problem lies in either the antenna system, or perhaps the power lead that supplies continuous 12 volts to the memory. It is very easy to forget to plug the antenna in during the installation.

If your radio reception is weak, the problem is possibly in the antenna system. Check the instructions to make sure any antenna adjustments have been made. Misadjustment of the antenna "trimmer," if there is one, will greatly affect at least the AM band.

A good way to check the antenna is to take a portable calculator and hold it against the antenna. If the antenna is working, you will hear all types

(Continued on page 90)

Kit Building Lives:

The Ramsey FX-146 Two-Meter FM Transceiver Kit

BY ELLIOTT S. KANTER, W4PGI

This kit will not only provide you with a polished working unit, but a valuable and enjoyable learning experience to boot.

For those of you to whom "code-free" meant finally getting your Amateur Radio License, Technician Class, welcome to the "fraternity." What remains now, besides waiting for your license to operate to arrive, is the selection and acquisition of a suitable VHF transmitter and receiver; or more likely, finding the right transceiver at an affordable price.

When we were first licensed (K4YOC), the choices were considerably broader, not to mention less expensive. The new ham could choose from equipment made by: Hallicrafters, Allied Radio (now Tandy Corp.), Swan, Heath, and a host of other companies who sadly are no longer (exception: Radio Shack/Tandy) on the ham-radio scene.

At that time, you could purchase a Benton Harbor Lunch Box, a relatively easy-to-build kit from the Heath Company, which put you on the VHF bands (10, 6, and 2 meters) for around $50, well within the reach of even the most cash-strapped operator. The lunch boxes were simple, low-power (about 5-watts output) vacuum-tube transceivers with a super-regenerative receiver section and an AM (voice)/CW (code) transmitter. With a little more money, you could then purchase some tools, an antenna system, and of course the required crystals. Even with all these extras, the total cost was still less than $100. To be totally honest, although the rigs were adequate and inexpensive, they left a lot to be desired.

Nowadays, we haven't got as many choices, especially if we want American-made equipment, and even fewer choices if we want to build our own. Heath is no longer active in the ham-kit field, Hallicrafters and Swan are no more, and only Tandy Corporation offers an American-made 2-meter handheld transceiver, assuming you have over $240 available. Which essentially leaves only Japanese-made equipment selling for at least $270, or another alternative that we'll soon discuss.

Examing the Choices. We'd established a budget of $200 for a transceiver, speaker/microphone, and a simple factory made or home-brewed antenna. Our technical requirements were as follows:

- True FM operation over the entire 2-meter band, with provisions for operation on either MARS or CAP frequencies.
- RF-power output of 4 to 6 watts from a standard 12-VDC source.
- Easy connections to/for subaudible tone-encoders, or touch-tone pads.
- Readily available connections for packet-radio operation.
- No more than 12 channels (simplex or repeater operation) required.

We realized that while one Tandy offering met some of our requirements, it was more expensive than we wished and it's ni-cad battery operation wouldn't suffice for normal mobile use or for use as a base-station system without some modification. Additionally, there was no easy provision for integrating our (as yet unpurchased) packet-radio system to the Tandy unit. As packet radio was high on our interest list, we decided the Tandy unit was not for us.

While we could have met some (if not all) of the requirements with a Japanese made, 2-meter unit, we still would've been faced with a "cost over-run," not to mention a lack of a couple of features we really wanted. On the other hand, it should be mentioned that these rigs also had some features that, while they would be very nice to have, would have been overkill. For example, living in a major metropolitan area (Atlanta, Georgia), we knew that we'd only be using a fraction of the raw-power or channel capabilities these "super-rigs" provided.

This research reinforced our desire to build our own transceiver, justifying the purchase of a kit, rather than a factory-wired and ready machine. This did not take into account the desire to "buy-American," nor the inner satisfaction that would come from being able to have the opportunity to actively participate in building our own station. After a considerable amount of additional research, we elected to equip our two-meter FM station with the Ramsey FX-146 kit, and optional case.

The FX-146 has a total of 12 user-programmable channels available. Counting the one channel we programmed for the National Weather Service, we were able to set up all our area's repeaters, plus the two national simplex frequencies (146.52–146.94 MHz), and still have four empty channels for expansion. There's also a provision for adding as many other frequencies in the 140–180 MHz range as you wish (more on that later).

From a financial standpoint, we would be allocating the following amounts of money for the items needed:

- FX-146 kit $149.95
- CFX-xx Case $24.95
- Microphone/Speaker $22.00

which comes to a total of $196.90.

While this total is just under our budgeted $200 and only leaves about $3.10 for an antenna (not counting shipping charges), we have been able to fulfill all of our desires and "wants" with a system having the specifications listed in Table 1. Based on that rather impressive list you can see why we decided to opt for the kit and build a unit ourselves.

The Instructions. There's a lot to be said about kits. They should allow you to reproduce a specific project by supplying you with all or most of the necessary parts, some form of chassis or circuit board, and some type of assembly guidance. The form and the quality of the instructions frequently separates a fair kit from the truly great kit. Through excellence, Heath set a standard for kit-building guides they called "step-by-step," and "step and check." You'd read a concise instruction, carry out the process, and then place a check mark in a box to acknowledge that you'd completed the task. Instructions were written directly and concisely, and placed in a well structured manual. In fact, you'd find the same information in exactly the same place in every Heath manual, regardless of the type of kit you were building.

Ramsey Electronics takes the Heath formula a step further by providing educational information in each of the construction phases. The transceiver kit is broken down into a total of nine stages:

- The DC-power input.
- The receiver audio amplifier.
- The integrated FM receiver.
- The antenna input and RF preamplifier.

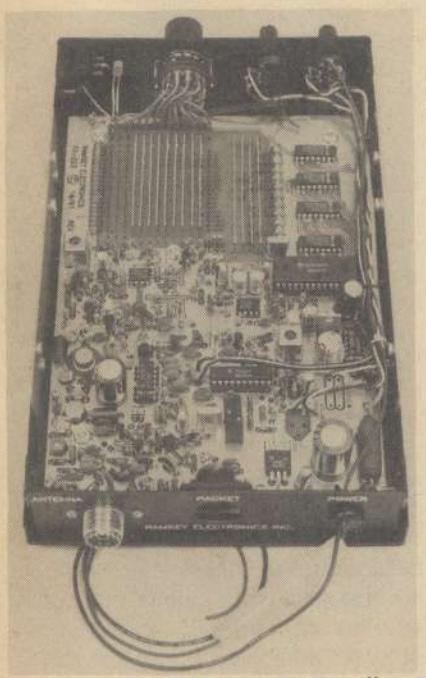
TABLE 1—FX-146 2-METER TRANSCEIVER SPECIFICATIONS

Frequency Range:	140 – 180 MHz
Tuning:	Any 20 MHz segment within the specified band. Diode programmable PLL synthesis, 12 front-panel selected frequencies expandable by remote switches.
PLL programming:	5 kHz steps with programmable transmit offsets.
Mode:	NBFM (narrow band FM)
Packet operation:	5-pin DIN connector (TXD, RXD, PTT, +12VDC, Gnd.)
Power requirements:	13.6 volts (±10%) @ 1.5 A (transmit) 200mA (receive), negative ground.
Antenna impedance:	50 ohms
Microphone impedance:	500-600 ohms or hi-impedance
T-R switching:	PIN Diodes
PTT circuit:	Solid State (standard ICOM-type mike connection).
Transmitter	
Final power out:	4-6 watts
Final output stage:	MRF237 or equal
Modulation:	True direct FM
Frequency deviation:	±5 kHz
Modulation distortion:	Less than 5%
Receiver	
Circuitry:	Double-conversion superhetrodyne, 1st IF 21.4 MHz, 2nd IF 455 kHz.
Sensitivity:	12 dB SINAD less than 0.035 microvolt.
Selectivity:	±7.0 kHz (−6 dB), ±15 kHz (−60 dB).
Squelch sensitivity:	Less than 0.25 microvolts.
Audio output:	More than 2 watts.
Circuit access points:	COR, RSSI, PL tone input, FSK demod., +12V, ±8V, +5V, PLL programming.
Case:	Heavy duty steel with aluminum front and back 9.75" L × 6.0" W × 1.5" H.

- The FX transceiver VCO (voltage-controlled oscillator).
- The FX transceiver synthesizer PLL (phase-locked loop).
- The diode matrix and PLL programming (programming the offset matrix).
- The microphone amplifier and push-to-talk circuit.
- Transmitter, buffer, driver, and final stages.

Each of these stages is prefaced by a detailed tutorial on the theory of operation and a functional description. It is effectively a mini-course preceding the construction of each phase of transceiver assembly and circuit integration. Having detailed information about why you are going to do something, together with how it works, makes construction of each of the nine stages educational, informative, and relatively trouble free. All of the construction steps are broken down into rather small groups to promote efficiency and accuracy. In most cases, there's a progress test at the conclusion of a series of instructions to verify performance as well as provide an opportunity (if required) to make adjustments or demonstrate the capabilities of the circuit just completed.

The manual is supplemented by two large drawings. The first of the PC board layout with component placement and board traces shown, and the second a schematic with the stages outlined in accordance to the nine phases of construction. For each stage, there was also a small scale drawing of the area of the PC board you'd be working with. Additionally there are supplemental small drawings as needed to highlight or detail points in a specific procedure backed up with text information.



As you can see, the transceiver is well populated with components and has the appearance of a factory-produced unit. Its appearance is due in part to the clear instructions that keep you from making mistakes along the way.

Here's the completed unit looking as smart as a tack. Can you tell the difference between it and a manufactured device?

To top all this off, the instructions even have a distinctive sense of humor. In fact, the manual is *so* complete and well written that you'll probably find yourself spending more enjoyable and educational time reading than building.

Before You Start. The FX-146 comes in a package about the size of a cigar box, weighing around four pounds. Once opened, you are greeted by literally hundreds of separate parts (there are over 100 type 1N914 diodes included in the kit alone). Some of the components are in taped reels, others are separate.

The manual first directs your attention to the different markings you'll encounter on specific components and gives you a quick tutorial on the resistor color code. It also informs you that this isn't an ordinary "we did everything for you" kit by alerting you to the fact that a component's value might vary as much as 10% from those listed. (In fact, the electrolytic capacitors used during construction may be either 4- or 10-µF units and still be perfectly suitable.) What that means is that you will need to be (or become) a genuine electronics technician, and not a blind follower as you proceed through the construction steps. Yet in

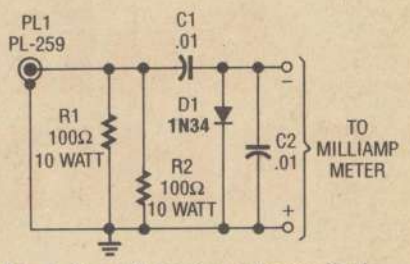


Fig. 1. You will require a dummy load, such as the simple one shown here, to test the transmitter stage of the unit.

cases where the tolerance is tight, the manual makes it quite clear and specifically states the exact value of the component as well as other identifying characteristics.

Naturally, you'll have to organize and separate the components to some degree; egg-cartons seem to be the best and least-expensive organizers. We tried several different approaches including muffin tins, ice-cube trays and other divided containers, but found ourselves returning to the egg carton as the best of all possible choices.

Tool and test-equipment requirements are quite modest. Solder is not included, and you'll need some screwdrivers, a wire cutter, a wire stripper, a ruler, a small soldering iron, a digital VOM, a fused 13.5-VDC power supply or battery, a 50-ohm dummy load (more about that later), a suitable microphone, and a speaker. We found that a length of solder-wick or some other form of desoldering aid was also handy.

With all this on hand and organized, we were ready to build. Everything went smoothly, and the entire process took only about 8½ hours.

Frequency Selection. When the

(Continued on page 91)

Build a TALKING COMPASS

With this project, you need not be able to see a dial pointer to determine the direction in which you are headed.

BY LARRY MITSCHKE

This project came about as a result of a search for a quick and easy method to provide telemetry for a remotely piloted vehicle (RPV)—in this case, a radio-controlled airplane carrying a video camera and TV transmitter. From a location on the ground, that set-up allows the pilot to watch a TV monitor and guide the plane through its paces without actually seeing the plane.

Unfortunately, with the plane flying so far away from the "home 40," it is easy to become disoriented and lose your sense of direction, which can make returning the plane to home base very difficult if not impossible. That's when I decided that an onboard compass would be necessary to avoid losing the plane. And since the pilot (myself) would not be in the cockpit where the compass heading might be checked, it was decided that an audible compass (whose output could be relayed by an audio input on the TV transmitter) was the easiest way to transfer that vital information to the pilot. That led me to develop the *Talking Compass* that is described in this article.

Circuit Description. Figure 1 shows a schematic diagram of the Talking Compass. The circuit is comprised of a directional sensor (or digital compass, MOD1), an ISD1016 analog storage device (U2), a 74S188 preprogrammed PROM (U3), and a handful of additional components.

The ISD1016, which is designed to record and playback analog signals (such as voice) will hold the recorded signal for more than ten years even with the power off. The chip provides a total storage time of 16-seconds, which can be used in one shot, or broken up into smaller segments. The segments can be as short as a tenth of a second. Because each tenth of a second of the total storage time is fully addressable by way of the chip's 8-bit binary address (pins 1 through 7, and 9 and 10), messages can be recorded on those small segments and individually selected for playback by accessing the proper address bus.

In our application, the total time is divided into eight 2-second segments. The starting point addresses for the eight 2-second segments are located at the binary equivalent of 1, 20, 40, 60, 80, 100, 120, and 140. By placing one of those binary numbers on the chip's address bus, a two second word or phrase can be recorded and/or played back.

Directional information is provided by MOD1, which uses a subminiature jewel-suspended magnet surrounded by four Hall-effect IC's. In use, the Hall-effect device that is directly opposite north turns on, causing its output to go to ground. The other outputs are held high by pull-up resistors R13 through R16.

As the sensor is rotated (say between north and east) two of the Hall-effect devices will be directly opposite north, so they both will turn on, thereby giving the intermediate direction (in the above example, northeast). The digital compass (MOD1) outputs directional information as a 4-bit binary code. That 4-bit information is transformed into 8-bit binary data by integrated circuit U3—a 256-bit bipolar PROM. Table 1 is the truth table for the 74S188 PROM.

The 8-bit data is used to select specific starting point addresses on the ISD1016 (U2), which can then be recorded to; or, if a message has been recorded at the specified address, it

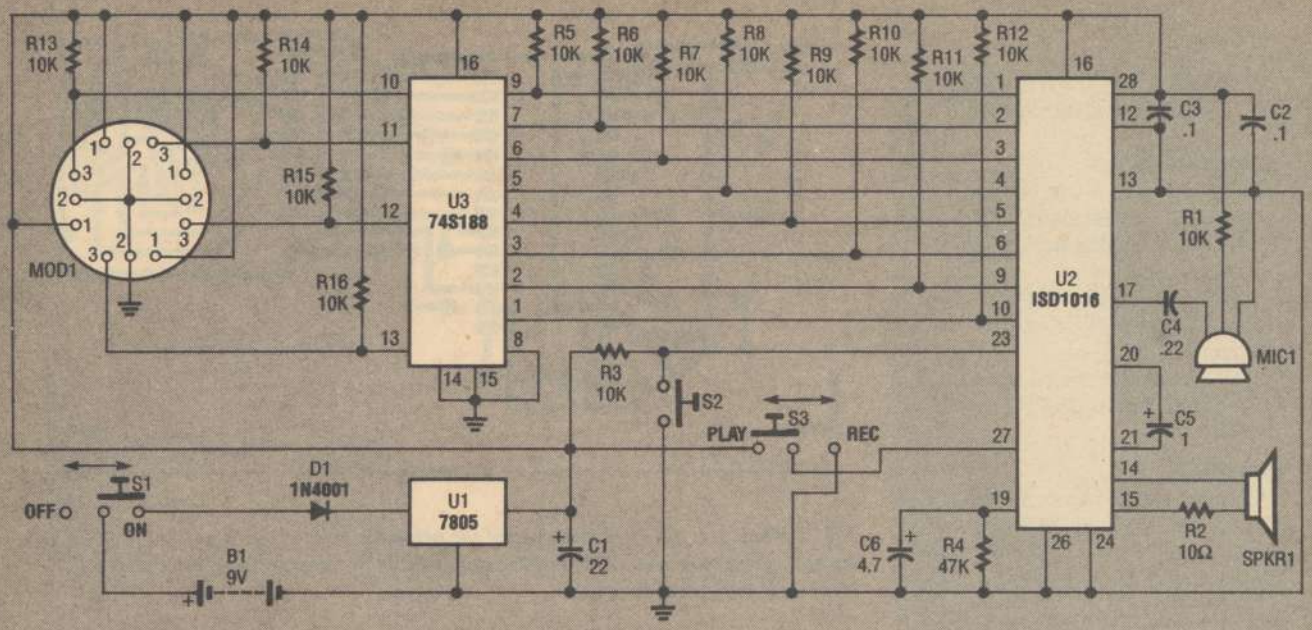


Fig. 1. The Talking Compass is comprised of a digital compass (MOD1), an ISD1016 analog storage device (U2), a 74S188 preprogrammed PROM (U3), and a handful of additional components.

TABLE 1—74S188 TRUTH TABLE

Directory	Input					Output								Decimal Equivalent
	A4	A3	A2	A1	A0	B0	B1	B2	B3	B4	B5	B6	B7	
North	L	H	L	H	H	0	0	0	0	0	0	0	1	1
N.W.	L	L	L	H	H	0	0	0	1	0	1	0	0	20
West	L	L	H	H	H	0	0	1	0	1	0	0	0	40
S.W.	L	L	H	H	L	0	0	1	1	1	1	0	0	60
South	L	H	H	H	L	0	1	0	1	0	0	0	0	80
S.E.	L	H	H	L	L	0	1	1	0	0	1	0	0	100
East	L	H	H	L	H	0	1	1	1	1	0	0	0	120
N.E.	L	H	L	L	H	1	0	0	0	1	1	0	0	140

can be played back. Switch S3 is used to select the mode of operation; record or playback. Switch S2 enables the recording or playback process chosen by S3. Diode D1 at the input to U1 (a 7805 5-volt voltage regulator) protects the circuit in case the battery is connected with its polarity reversed, which would ruin the compass sensor. The speaker connects directly to U2, which has its own output amplifier.

Construction. Begin by making a printed-circuit board; a full-size printed-circuit pattern is provided in Fig. 2. After etching and drilling the board, clean the traces with steel wool and check for shorts.

Begin assembling the board by installing IC sockets for U2 and U3, guided by the parts-placement diagram shown in Fig. 3. Follow that with the resistors and the capacitors; then diode D1, the digital compass (MOD1), and the voltage regulator (U1). Solder wires to the appropriate pads on the board for connection to the off-board components (battery connector, speaker, switches, and microphone).

Once the circuit has been checked for faults, put the assembly aside for a while, and prepare the enclosure that will house your project. The circuit must be housed in a non-magnetic enclosure (such as Radio Shack's #270-223 plastic project box). Whatever housing you select, make sure that it allows the speaker to be separated from the digital compass by at least 4 inches (center to center) so that the speaker magnet will not affect the operation of the compass.

It will be necessary to drill mounting holes in the side of the enclosure for the switches. A hole for the microphone along with speaker grille holes should also be drilled in the lid of the enclosure. Once the holes have been drilled, mount the off-board components to the enclosure. The speaker can be mounted using silicon sealer or some other suitable adhesive. The microphone element can be secured to the lid of the enclosure by placing a rubber grommet in the microphone hole and just pressing MIC1 into place.

Once the off-board components have been mounted to the enclosure, install the circuit board and connect the off-board components to the circuit board using hookup wire. Be sure that when the lid is attached to the enclosure, the compass is located at the end opposite the speaker. Label the playback/record (S3) and on/off (S1) switches.

Install a battery using double-sided foam tape to hold it in position and check for correct voltage at U2's and U3's power terminals. Also check for continuity to common at the ground terminals of those IC's. Next install the two DIP IC's (U2 and U3). Remember that the ISD1016 is a CMOS device, and is thus sensitive to electrostatic discharge.

Now comes the moment of truth:

Operation. To record a message, place S3 in the REC (record) position and apply power to the circuit. Rotate the box to the direction (east, west,

PARTS LIST FOR THE TALKING COMPASS

SEMICONDUCTORS

U1—7805 1-amp, 5-volt, voltage regulator, integrated circuit
U2—ISD1016 analog storage device, integrated circuit
U3—74S188 256-bit PROM (preprogrammed), integrated circuit
MOD1—Dinsmore digital compass
D1—1N4001 1-amp, 50-PIV, rectifier diode

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1, R3, R5–R16—10,000-ohm
R2—10-ohm
R4—470,000-ohm

CAPACITORS

C1—22-µF, 16-WVDC, tantalum
C2, C3—0.1-µF, ceramic-disc
C4—0.22-µF, ceramic-disc
C5—1-µF, 16-WVDC, axial-lead electrolytic
C6—4.7-µF, 16-WVDC, axial-lead electrolytic

ADDITIONAL PARTS AND MATERIALS

S1, S3—DPDT slide switch
S2—SPST momentary pushbutton switch
SPKR1—8-ohm, 0.2-watt, 2-inch speaker
MIC1—Electret microphone element
B1—9-volt transistor-radio battery
Printed-circuit materials, enclosure, 9-volt battery holder and connector, grommet, adhesive, wire, solder, hardware, etc.

Note: The Digital Compass (MOD1), part #1490, is available from Dinsmore Instrument Co., 1814 Remell St., Flint, MI 48503, for $12.00 each, plus $0.52 postage. Michigan residents must add appropriate sales tax.

The ISD1016 analog storage chip (U2) is avalible from Information Storage Devices, Inc., 2841 Junction Avenue, Suite 204, San Jose, CA. 95134, for $27.99 each postpaid. California residents must add appropriate sales tax.

The 74S188 256-bit preprogrammed PROM (U3) is available from Funtech, P.O. Box 772747, Houston, TX 77215-2747, for $5.99 each postpaid. Texas residents must add appropriate sales tax.

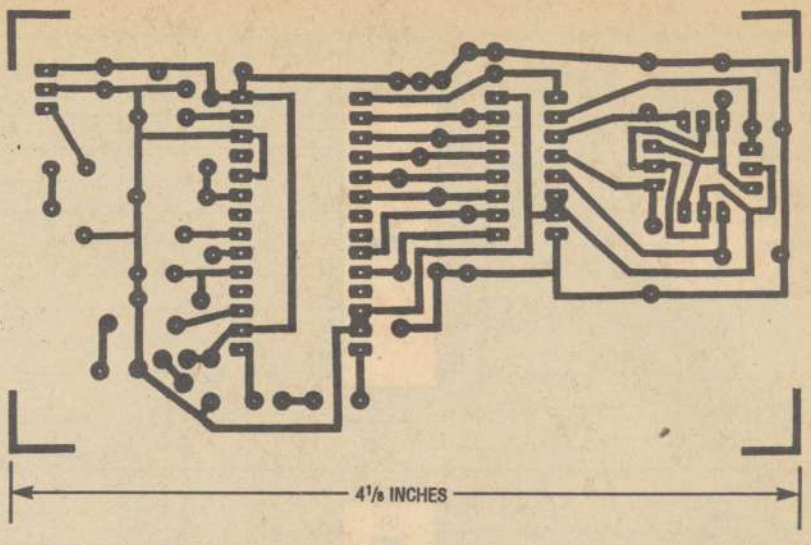


Fig. 2. Here is a full-sized template of the printed-circuit artwork used to produce the author's prototype unit. After etching and drilling the board, clean the traces with steel wool and check for shorts.

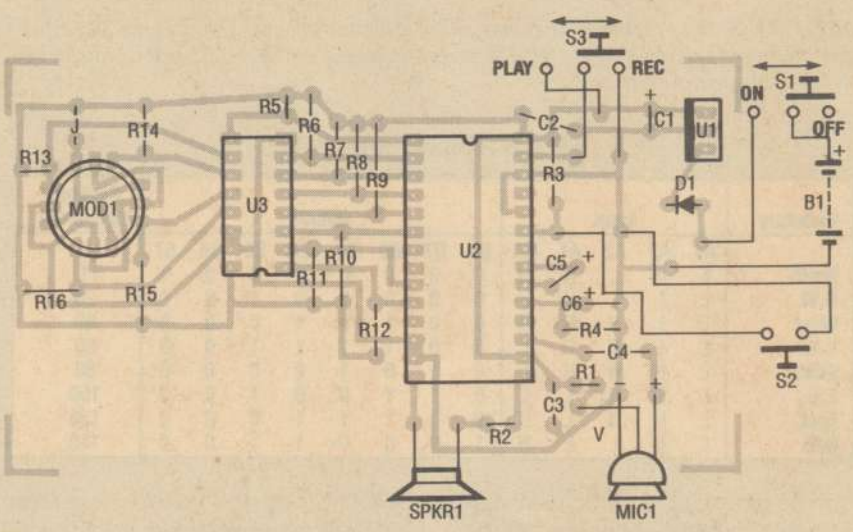


Fig. 3. Assemble the board guided by this parts-placement diagram, beginning with the IC sockets for U2 and U3, followed by the resistors and the capacitors; then diode D1, the digital compass (MOD1), and the voltage regulator (U1).

north, or south) that you want to record and make sure that the project is level. Press S2 and speak into MIC1. When through speaking, release S2 to stop recording. You have two seconds to record your phrase or word. You could say "north" or a quick "you're facing north." I have found it better to face off to one side while speaking so that your breath does not hit the microphone and produce wind noises when recording "s" and "th" sounds.

Check the recording by placing S3 in the PLAY (playback) position, and with the box pointed in the same direction momentarily press S2. The compass should play back what you've recorded. It is not necessary to hold S2 down; just a quick press and release is all it takes.

Go through the recording process with all 8 direction points, positioning the compass to point in each direction. Remember that the sensor is internally damped and it takes a couple of seconds for it to stabilize in the correct direction when setting up for recording or playback. If you attempt to record messages that are longer than two seconds, the recording will run over into another section and erase whatever might have been stored there. But it is a simple matter to re-record both.

It is possible to playback everything

(Continued on page 88)

Making The Connection

Make the right connection between a wire antenna and your rig.

BY JOSEPH J. CARR

There is large amount of information on wire antennas available to receiver users. However, two related topics that seem lacking in coverage, or at least jumbled up with other material, are antenna-construction and termination. In this article, we will take a look at both topics. As we proceed, keep in mind that the information applies to nearly all wire antennas, not just the types mentioned.

Types of Wire Antennas. The variety of wire antennas around is mind boggeling, but they fall into two basic categories. One group is like the Marconi-style antenna, shown in Fig. 1A, consisting of a single-wire radiator, usually made of insulated or uninsulated No. 14 or No. 12 wire placed high in the air. The antenna is typically supported by a set of end insulators and rope supports. One end of the antenna is connected to a piece of insulated wire (called the "downlead"), which is connected to the rig (receiver, transmitter, or transceiver).

Related antennas include the random-length wire antenna, long-wire antenna (both resonant and nonresonant types), windoms, Tee-antennas, and top-hat antennas to name a few. They are all different, but have one similarity: they consist of a single radiator element connected to a single-wire downlead that is connected to the radio rig.

Someplace before the downlead enters the house, a protective lightning arrestor is connected to the circuit. The lightning arrestor is used to bypass as much of a lightning strike as possible to ground. The ground wire connected to the lightning arrestor is made of heavy wire or braid cut as short as possible, and is connected at the other end to a ground rod driven into the ground. Always follow local electrical and safety codes for the ground rod, which in most cases means you should use an 8-foot copper-clad steel rod. Those little 4-foot ground rods are not terribly good for lightning protection, so don't depend on them.

The downlead is connected directly to the rig's antenna terminal. A second ground, which may go to the same ground lead as the lightning arrestor ground, is used to improve the RF performance of the radio antenna.

The other basic type of antenna is shown in Fig. 1B. That antenna is a dipole. Such antennas consist of two wire radiators fed by a two-conductor cable such as twin-lead, twisted-pair or, most commonly, coaxial cable. When coaxial cable is used, the center feed point may be either a special center insulator or a BALUN (BALanced UNbalanced) transformer. Again, end insulators and rope supports hold the antenna in the air. As with all antennas, a lightning arrestor is used to protect the house and rig.

End and Center Insulators. End insulators are used to electrically isolate the wire radiator from the support rope. In addition, they provide a certain amount of mechanical strength in the connection between the radiator wire and the rope supports. They may be made of glass, glazed ceramic, or a synthetic material such as nylon or Teflon.

Figure 2 shows one popular shape of the classic ceramic end insulator. Most of those sold in stores today are made of synthetic material, although used ceramic and glass insulators can be frequently seen at hamfests.

Two synthetic end insulators are shown in Fig. 3. The larger one shown can be used for high-power ham-radio transmitter antennas as well as general-receiver antenna use. It provides a much larger degree of isolation between the wire and the supports (which presumably reduces end effects). The smaller unit is used for smaller transmitter antennas, and general shortwave-receiver antennas.

A pair of popular center insulators are shown in Figs. 4 and 5. The type shown in Fig. 4 has an SO-239 UHF

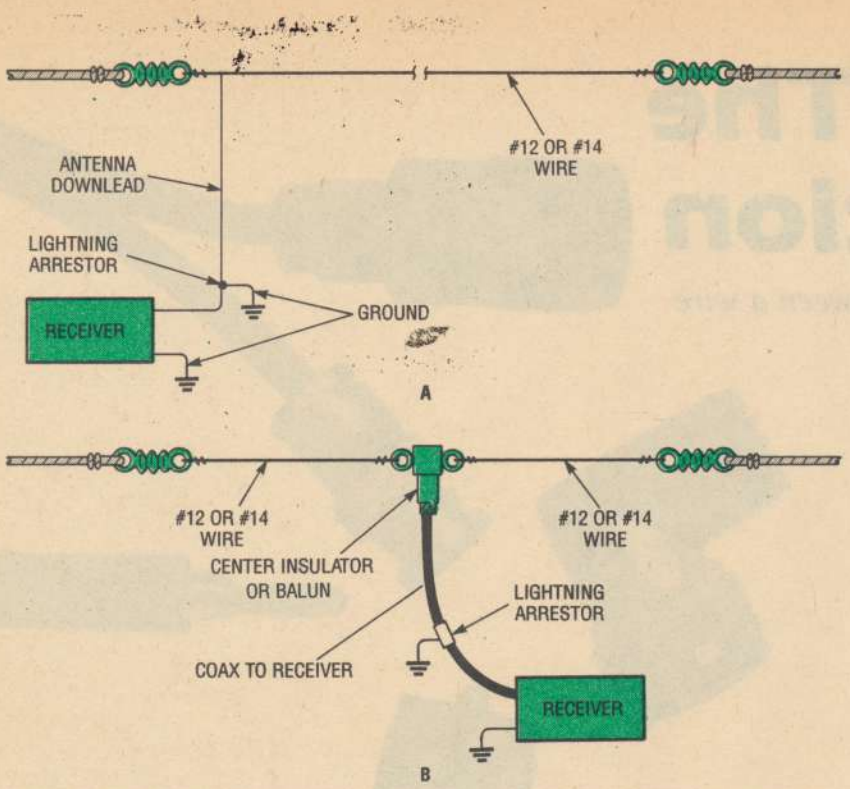


Fig. 1. The two most common antenna types—the Marconi-style antenna (A) and the Hertzian "balanced" antenna (B)—are shown here. Note the additional radiator in B.

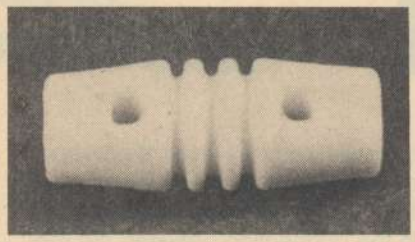


Fig. 2. End insulators come in different styles. Here is a "classic" end insulator made of glazed ceramic. Some can still be found at ham shows today.

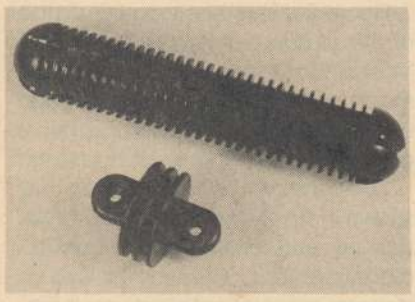


Fig. 3. The modern end insulators are typically made of a synthetic material such as nylon. That makes them fairly resilient

coaxial connector, that can mate directly with the PL-259 coaxial connectors used on many antenna feedlines. The radiator elements are connected to heavy-duty, solid-copper wire "pigtails" protruding out each end of the center insulator. (Connections for this type of center insulator will be discussed later.) A different form of center insulator is shown in Fig. 5. In that type of insulator, a hollow body of PVC-like plastic material contains connections for the SO-239 coaxial cable. The wires are connected to, and supported by, a pair of screw/eye terminals on either side.

Some center insulators contain BALUN transformers. For ordinary dipoles use 1:1 BALUN transformers; for folded dipoles use 4:1 BALUN's.

Using Insulators. There are two goals to keep in mind when making connections to either end insulators or center insulators. First, you want a strong, reliable mechanical connection that won't come loose under the buffeting the antenna will receive. Winds and weather can take a terrible toll on wire antennas, so a good, reliable connection is mandatory. The second goal is to make a good electrical connection—after all is said and done, the antenna is still an electrical device connected to an electronic circuit.

A minor point to make is to avoid kinks. Radiator wire is either hard-drawn copper wire or copper-clad steel wire (*e.g.*, Copperweld), so keep

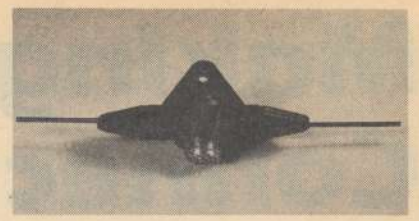


Fig. 4. Some center insulators have "pigtails" on each side that the radiators need to be soldered to. The antenna's downlead attaches to the connector at the bottom of the insulator.

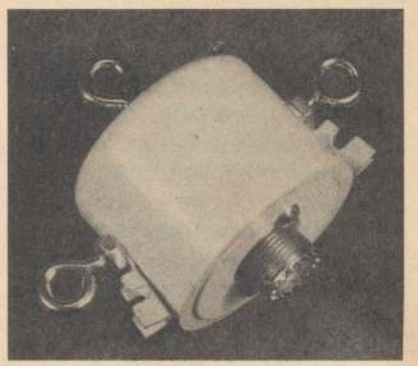


Fig. 5. This type of center insulator has crimp-on lugs for a good electrical connection. These center insulators sometimes contain BALUN transformers.

in mind that it kinks up very easily. In fact, experienced antenna erectors claim that gremlins or RF demons exist whose main function in the universe is to put permanent kinks in wire. When the wire kinks, it is nearly impossible to get the kink out of the wire so that it looks good again. The antenna will still perform well, but the spot where the kink occurred will always remain.

Let's deal with end insulators first. Figure 6 shows how to make a connection to an end insulator. Although only one style insulator is shown here, the method for the other styles shown earlier is identical.

The first step in connecting the antenna wire to the insulator is to pass the wire through one of the holes in the insulator. Leave 6 to 8 inches of free wire. Next, double the free end of the wire back on itself, and wrap it around the main body of the wire six to eight times; leave about ¾- to 1-inch of loop to permit the insulator to move freely. If a downlead is required, as it will be on one end of a Marconi-style antenna, then strip away about 2 inches of its insulation, and then wrap the bare downlead wire around the main antenna wire four to eight times.

The final step is to solder all the con-

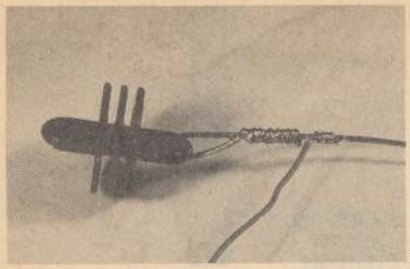


Fig. 6. To make a connection to an end insulator, you first insert some wire into an eyelet, twist it over on itself 6–8 turns, and then solder.

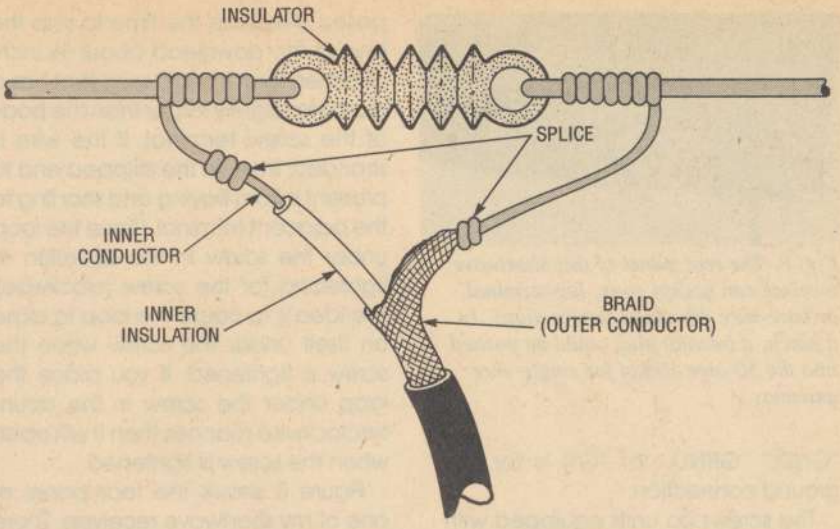


Fig. 7. The split-coax method of making center connections shown here is not advisable, as the connection is prone to corrosion.

nections. The purpose of the solder is not to add mechanical strength, but to ensure the electrical connection in the face of potential corrosion. Use either 50/50 or 60/40 lead/tin resin-core solder. Use solder marked "resin core," "radio/TV," or "electronic" solder. Under no circumstances use acid-core solder! That solder will eat the antenna wire away. It is marked "plumber's" solder, or something similar. Also avoid coreless solder. It can only be used with separate acid-core flux, and is useless to wire-antenna constructors.

Use at least a 150-watt soldering iron or soldering gun. A small pencil-type iron (typically less than 75 watts) is not suitable for this purpose. Heat the joint thoroughly, and then apply the solder so it completely coats the wire of the support splice and the downlead splice. You may find that the area where you apply the iron will turn out well coated with solder, but other areas aren't wetted at all, so be sure to turn the wire over and solder all surfaces.

Apply caution when soldering. Solder must be very hot to melt, and the wire junction and its vicinity (even the insulator) will try to "sink" the heat, so don't touch it with your bare hands! It can cause painful first- and second-degree burns. Handle the wire and the insulator with insulated pliers, or some other heat-handling tool.

The procedure for connecting a center insulator depends on the type of center insulator that is used. Figure 7 shows the use of an ordinary end insulator as a center insulator for a dipole or other balanced antenna. The two wire radiators are spliced onto the insulator in the normal manner for end insulators. The coaxial cable is stripped such that its center insulator and conductor are each routed to one of the antenna radiators, while the braid (outer conductor) is routed to the other. Both are spliced to their respective radiator elements. One popular method is to use the pigtails left over from making the two support splices as electrical connections for the coaxial cable.

In some cases, the body of the coaxial cable is wrapped around the center insulator and tied off with string, cord, or fishing line in order to provide mechanical support for the connections. If you use the "split coax" method, then a strain relief is essential.

The method shown in Fig. 7 is not recommended. It is mechanically weak, and open to the weather. It is common to find water infiltration into the coaxial cable, which deteriorates its performance. It is better to use a regular center insulator or a BALUN transformer.

The type of center insulator shown back in Fig. 4 has heavy, solid copper-wire pigtails protruding from inside the insulator. Before beginning the splice, you must tin the pigtails. That is, heat up each one with a soldering iron and spread a thin coating of solder over them. They should look silver plated and smooth after they are tinned.

The antenna wire is laid alongside each copper pigtail, and in contact with it, and is then passed through the hole in the insulator, doubled back on itself, and then wrapped around both the pigtail and its own main body six to eight times. It thus resembles an ordinary end insulator support splice, except for the pigtail in the core. Finally, using a soldering iron or gun, solder the splice thoroughly in the same manner as for support splices.

The method for connecting the other type of center insulator (shown back in Fig. 5) is similar to the technique for an end insulator. You pass the antenna wire through an eyelet, and leave about 8 to 10 inches of wire free when you pass it through. Then wrap the wire back on itself until you have about 5-inches of the free end left. The end left over is then connected to the terminal lugs fastened to the eyelet. It is prudent to pull the lug away from the body of the insulator so it can be later crimped and soldered without melting the plastic body. Pass the end of the wire all the way into the terminal past both sets of flanges, and then crimp the flanges over the wire with long-nose pliers in order to form a good mechanical joint. Next, solder the terminal and wire together.

The Rig End. There are a variety of connectors used for connecting antennas to receivers and transmitters. If the connector on your antenna compliments the one on your receiver, you just have to plug them together. If the two connectors do not mate, you could just buy an adapter to bridge the connection.

Some receivers are equipped with a two- or three-station screw terminal instead of a connector. On a two-screw terminal block, one screw (often labeled "ANT" or "A") is for the antenna and the other (labeled

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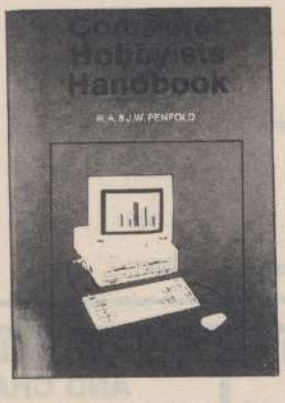

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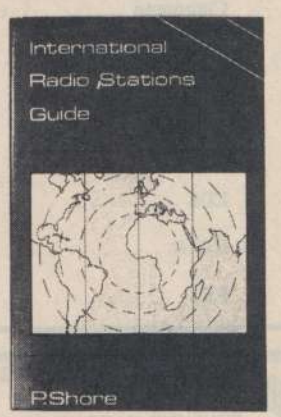

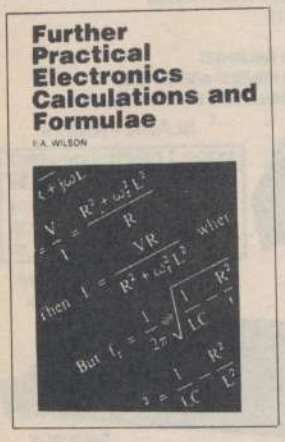

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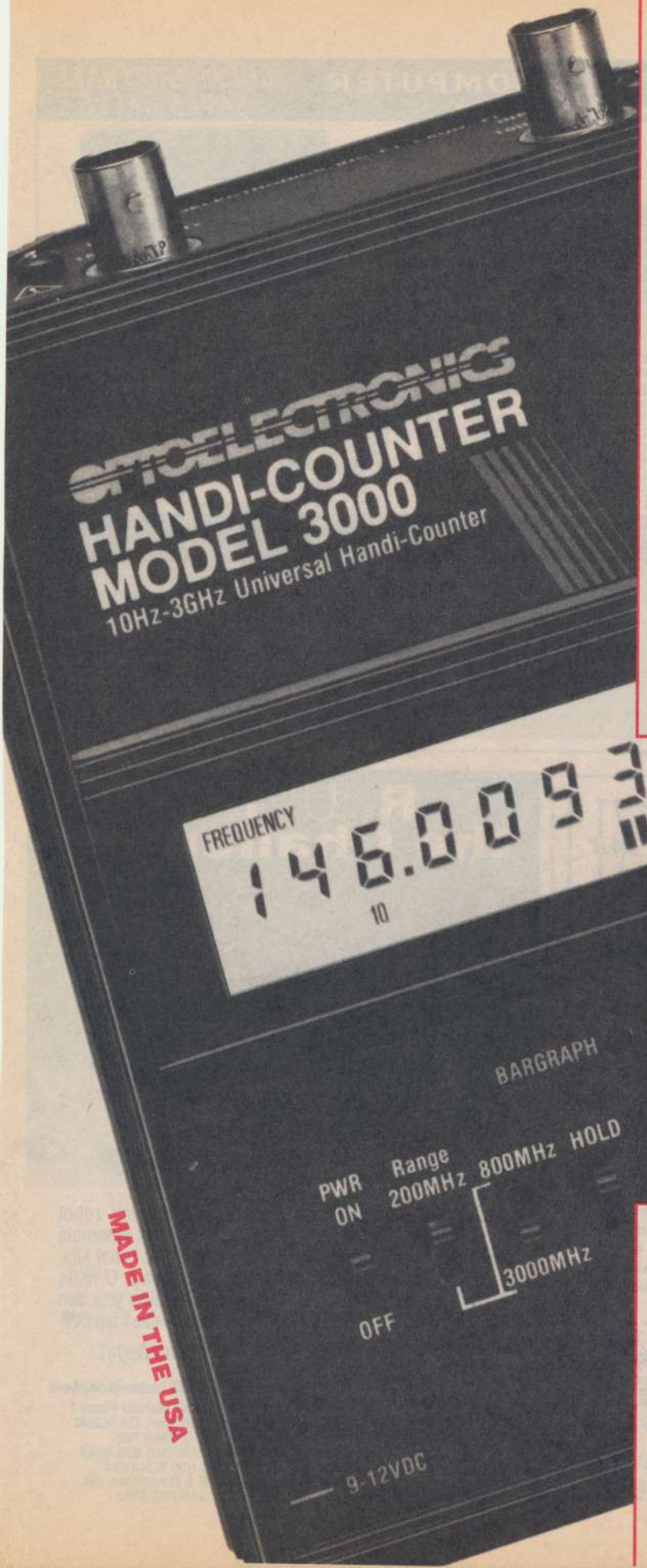

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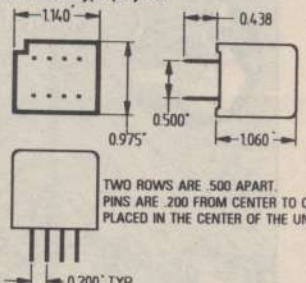

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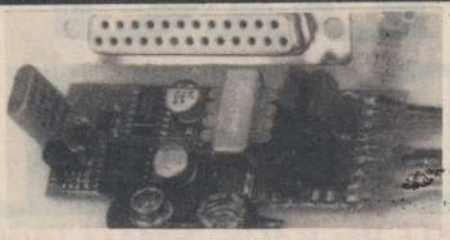

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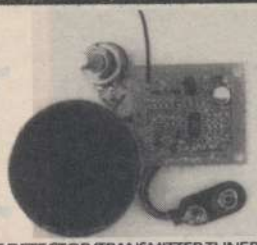

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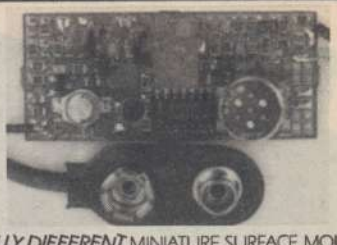

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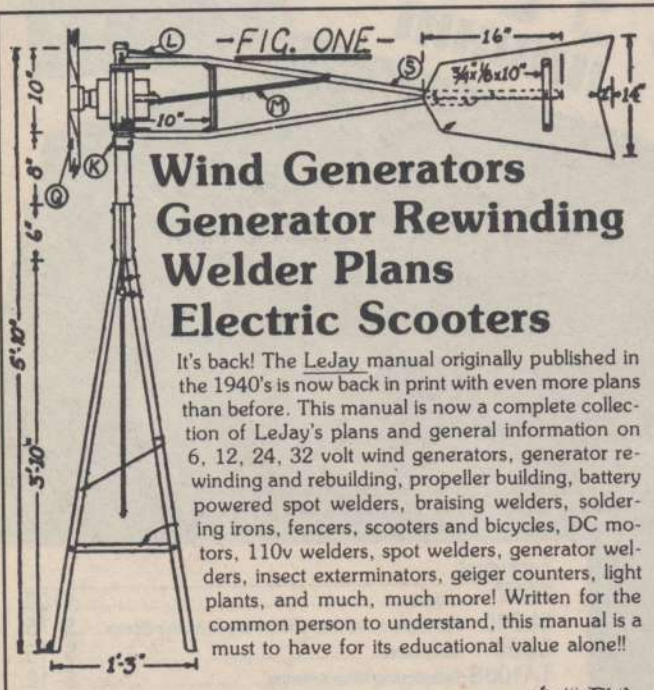

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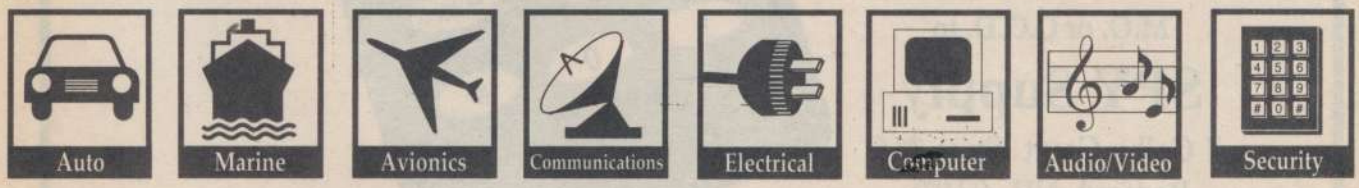

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#22 ..... 3.65	#32 ..... 4.40		

TOROIDS

IRON		FERRITE	
T-25-2	.40	FT37-43	.60
T-25-6	.40	FT37-61	.60
T-37-6	.45	FT37-77	.60
T-37-12	.45	FT50-43	.75
T-50-2	.55	FT50-61	.75
T-50-3	.55	FT50-77	.75
T50-6	.55	FT82-43	1.00
T68-0	.75	FT82-67	1.00
T68-2	.75	FT82-68	1.00
T68-6	.75	FT114-61	2.15
T80-2	.85	FT140-43	4.10
T200-2	4.00	FT240-61	8.00

WE STOCK A COMPLETE LINE OF TOROIDS AND BEADS.

Q-DOPE

Solution of pure polystyrene in solvents. Dries fast and leaves a clear, protective coating on toriods, coils and transformers, with no or minimal effect on inductive values. May also be used as a cement for molded or fabricated items made of polystyrene.

(Bottle with Brush 2 fl. oz. 59 ml) **$3.75**

CD22402E

CMOS LSI Sync Generator

$9.95

MAKE CIRCUIT BOARDS THE NEW, EASY WAY WITH TEC-200 FILM

JUST 3 EASY STEPS:

- Copy circuit pattern on TEC-200 film using any plain paper copier
- Iron film on to copper clad board
- Peel off film and etch

Convenient 8 1/2 x 11 size

With Complete instructions

5 SHEETS $6.25

10 SHEETS $10.75

20 SHEETS $16.25

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3 AMP $29.50

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6 AMP $46.50

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30 AMP $149.50

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Double balance Mixer

LO/RF - 1-500MHz

RF DC - 500 MHz

$6.75

MINIATURE TOGGLE SWITCHES

3A 125V Solder Terminals

SPDT ..... ON-ON **$1.25**

DPDT ..... ON-ON **$1.50**

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DIGITAL LCR METER measures inductance, capacitance and resistance At Last! An LCR meter that everyone can afford. Now you can measure coils, transformers, chokes from 1µH to 200H Capacitors from .1 pfd to 200 mfd and resistors from .1 ohms to 20 meg ohms. All in one handheld instrument.

MODEL LCR-1801 ..... $119.95

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1-1/2" Diameter 0-10 Marking **$8.25**

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Balanced Mixer/OSC. Popular IC among experimenters for building DC and super-het receivers.

$2.49 ..... BUY 3 OR MORE ... $2.25

200 WATT INVERTER

Plugs into your lighter and runs:

- Ham Equipment
- Lights
- Soldering Iron
- Computer
- Power Tools
- Shaver
- 13" TV with VCR
- MUCH MORE

Model: POW 200

Input: 10 to 15 volts DC

Output: 115 volts AC true RMS

Power: 400 Watts peak
200 Watts for 2 minutes
140 Watts continously
5" x 2.6" x 1.7"

Weight: 15 ounces

Warranty: 3 year

$99.95

QRP CW TRANSCEIVER KIT

- Covers 14.0 MHz to 14.1 MHz on 20 M or covers 7.0 MHz to 7.150 MHz on 40M
- Available on 20M or 40M band
- Superior Superhet
- Single signal receiver
- CW crystal ladder filter
- VFO tuning with vernier dial
- RIT w/center detent control
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QRP-20 ..... 20M VERSION $149.95

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This handy tester is both a signal generator and receiver. As a generator use it to check out an amplifier, stage by stage. Also tests AM radio IF and RF stages. As a receiver you can pin point where a defective part exists. Will transmit and receive simultaneously.

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Hand held Digital Logic Probe provides convenient and precise use in the measurement of logic circuits. It displays logic levels (high or low), pulses and voltage transients down to 300 nanoseconds. High intensity LED readouts provide instant response to the logic state.

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MFG. SYLVANIA ..... **$16.95** Each

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Measures approx. 1 1/2"W x 1 1/4"D x 7/8"H. **$4.00**

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Rated 500MA

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Universal plug

$5.95

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1N4004	.10
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1N4007	.17
1N5400	.20
1N5401	.20
1N5402	.20
1N5404	.25
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50C1

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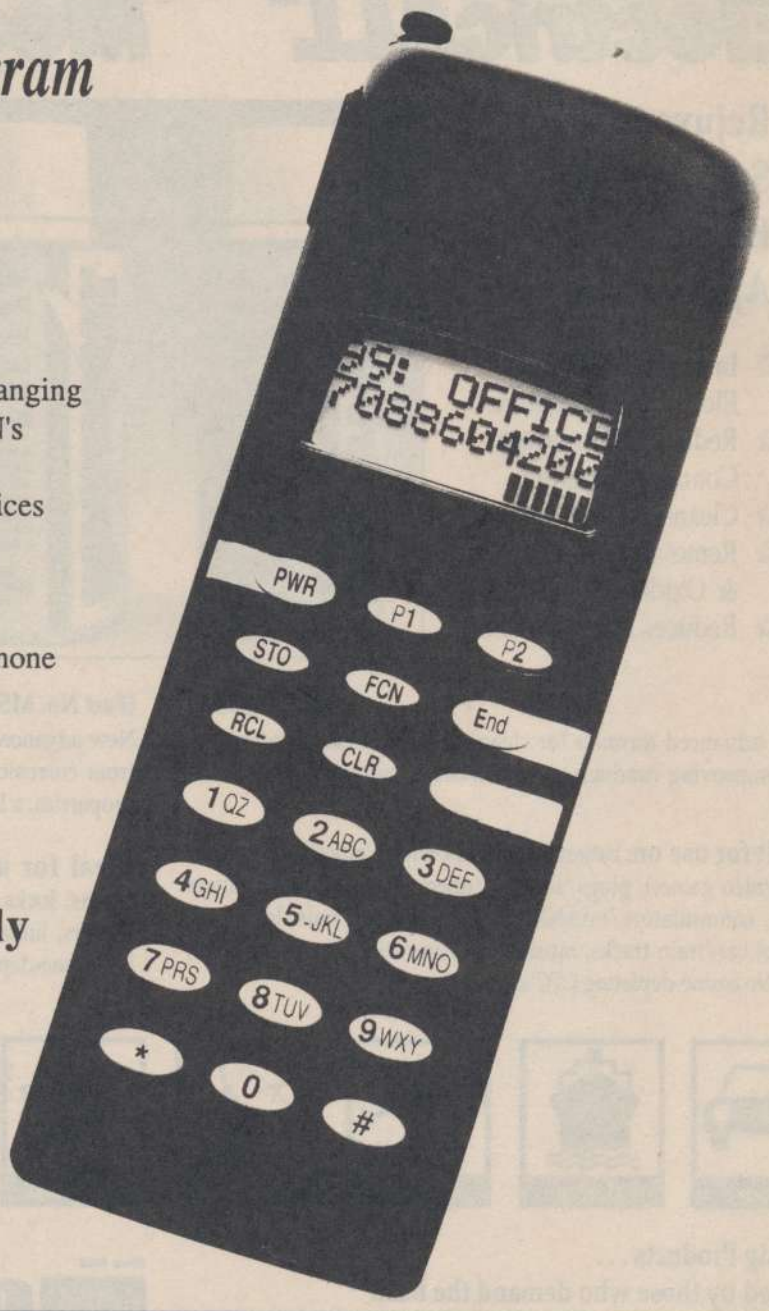
- Cellular phone manufacturer's ESN codes



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INSTRUCTION FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.00per word. Minimum charge is $15.00 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by April 14 will appear in the August, 1991 issue that is on sale June 18. The PE Market Center is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

AD RATES: $1.00 per word, Minimum $15.00.

Send your ads with payment to:
Popular Electronics Market Center, 500-B Bi-County Blvd. Farmingdale, NY 11735

CATEGORIES

100 — Antique Electronics
130 — Audio-Video-Lasers
160 — Business Opportunities
190 — Cable TV
210 — CB-Scanners
240 — Components
270 — Computer Equipment Wanted
300 — Computer Hardware
330 — Computer Software
360 — Education
390 — FAX
420 — Ham Gear For Sale
450 — Ham Gear Wanted
480 — Miscellaneous Electronics For Sale
510 — Miscellaneous Electronics Wanted
540 — Music & Accessories
570 — Plans-Kits-Schematics
600 — Publications
630 — Repairs-Services
660 — Satellite Equipment
690 — Security
710 — Telephone
720 — Test Equipment

CLASSIFIED AD COPY ORDER FORM

Ad No. 1—Place this ad in Category # _____

1 - $15.00	**2** - $15.00	**3** - $15.00	**4** - $15.00
5 - $15.00	**6** - $15.00	**7** - $15.00	**8** - $15.00
9 - $15.00	**10** - $15.00	**11** - $15.00	**12** - $15.00
13 - $15.00	**14** - $15.00	**15** - $15.00	**16** - $16.00
17 - $17.00	**18** - $18.00	**19** - $19.00	**20** - $20.00
21 - $21.00	**22** - $22.00	**23** - $23.00	**24** - $24.00
25 - $25.00	**26** - $26.00	**27** - $27.00	**28** - $28.00
29 - $29.00	**30** - $30.00	**31** - $31.00	**32** - $32.00
33 - $33.00	**34** - $34.00	**35** - $35.00	**36** - $36.00
37 - $37.00	**38** - $38.00	**39** - $39.00	**40** - $40.00

Total classified ad Payment $ _____ enclosed.

[ ] Check [ ] MasterCharge [ ] Visa ($15.00 minimum credit card order)

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All Caps words _____ × .20 per word = $ _____

Bold words _____ × .20 per word = $ _____

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TOTAL COST OF AD No. 1 $ _____

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Expiration Date _ _ / _ _

Signature _____

Name _____ Phone _____

Address _____ City State Zip _____

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ARGON * BOOKS
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XANDI Electronics

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The use of surface mount technology makes this the smallest FM transmitter you can buy! This is not a toy, it out performs most units on the market today. Our E-Z-kit has all the surface mount parts preassembled to the circuit board.
XST500(E-Z) E-Z Kit $39.95

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XSP250(E-Z) E-Z Kit $29.95

The XTR100 Tracking Transmitter transmits a continuously beeping tone that can be received by any FM receiver. Can be used for games, contests, or as an anti-theft device.
XTR100(C) Kit $39.95

The XFM100 FM transmitter has a range of up to 1 mile. It works with any standard FM receiver. It contains a built in high gain two stage audio amplifier for maximum sensitivity.
XFM100(C) Kit $35.95

The XTT100 is a battery powered phone transmitter with a range of up to one mile. It only transmits when the phone is being used in order to conserve battery life.
XTT100(C) Kit $35.95

The XBD200 quickly locates hidden transmitters from 1 to 2000 MHz by emitting an audio output proportional to the transmit level.
XBD200(C) Kit $44.95

Use the XPS100 to call your home from any other phone and listen in using the built in microphone and amplifier.
XPS100(C) Kit $45.95

The XPB1 is a telephone transmitter capable of transmitting to any FM receiver up to a 1/4 mile away. Powered by the telephone line it requires no batteries.
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WRITE FOR A CATALOG

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CIRCLE 39 ON FREE INFORMATION CARD

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XL - 103

550 MHZ - 86 Channel $89.95 each

TOP CHANNEL ROLLOVER, LAST CHANNEL MEMORY, SUB-CHANNEL 0+1 CAPABILITY, FAVORITE CHANNEL, SURGE PROTECTION, 4 db AMP, DECODER COMPATABLE, STD/HRC SWITCHABLE, ONE YEAR REPLACEMENT WARRANTY, A/B TWINLINE OPTIONAL

$70.00 each - 5 Lot

$65.00 each - 10 Lot

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MXC-2520-525 MHZ remote volume
remote volume control
Audio/video Baseband **$119.95** ea.
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AMERICAN MADE Keep *OUR* People Working

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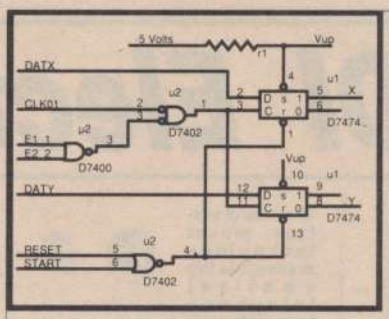

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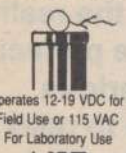

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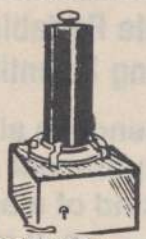

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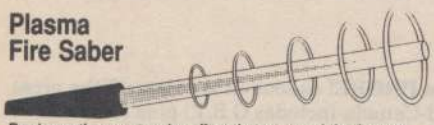

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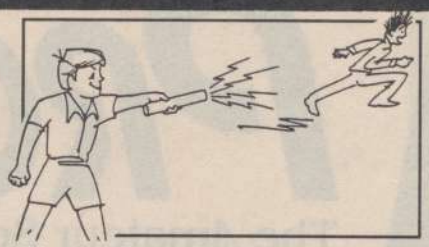

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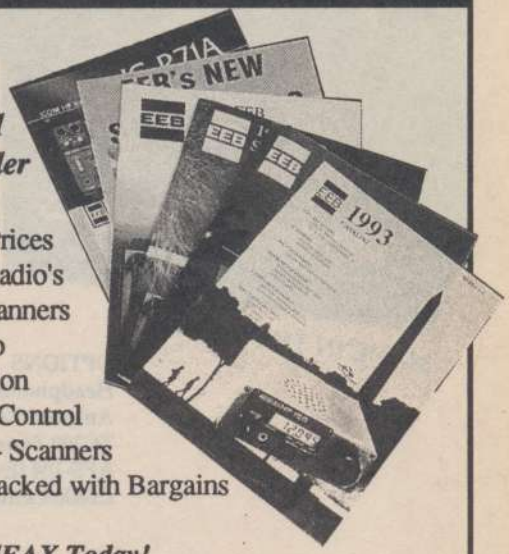

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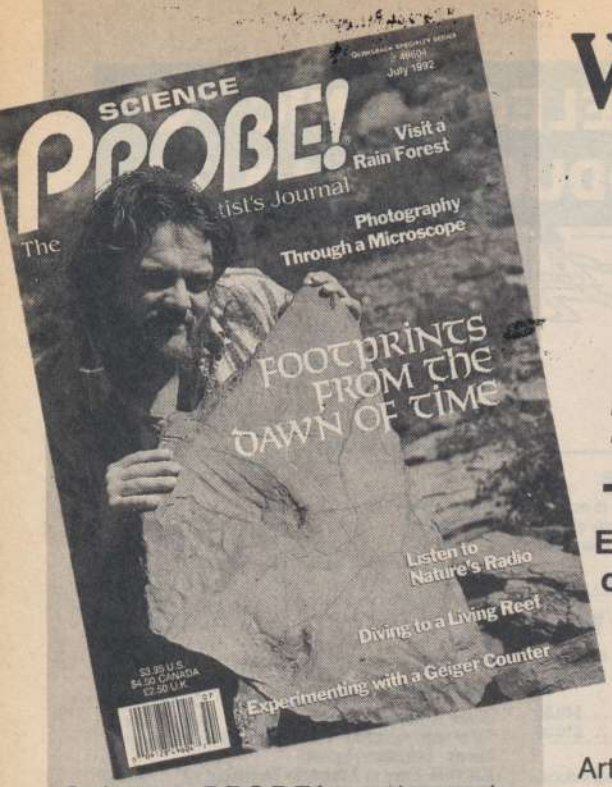

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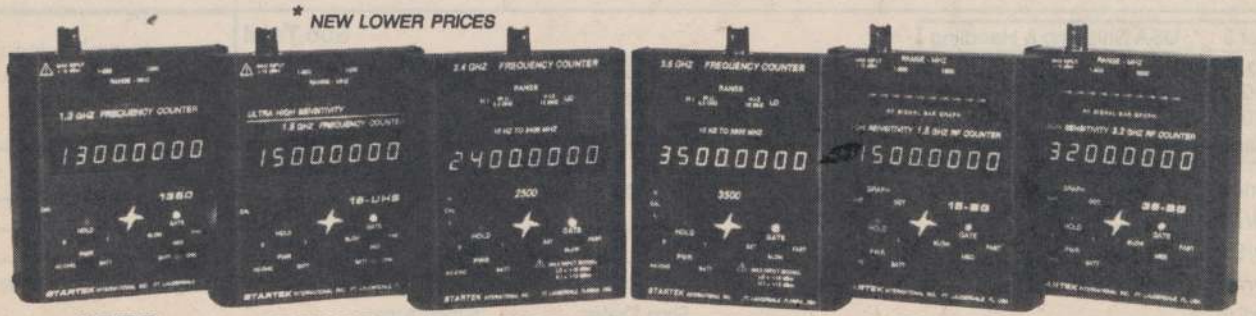

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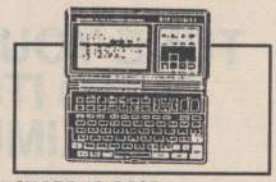

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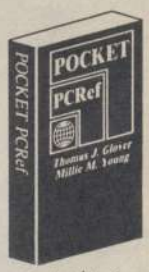

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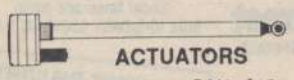

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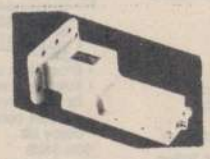

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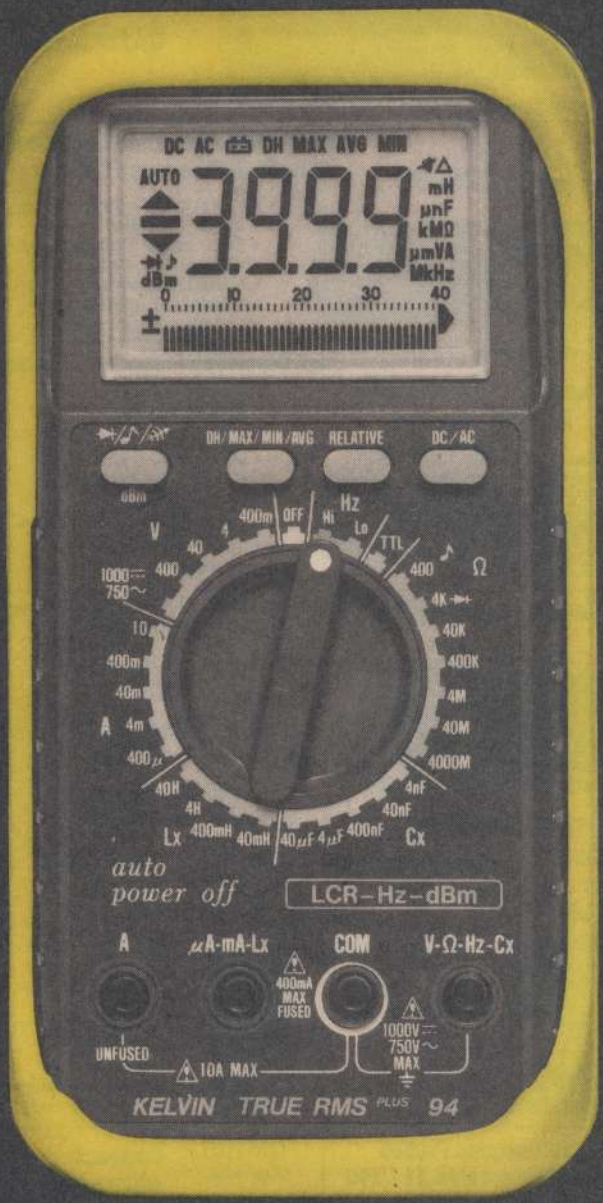

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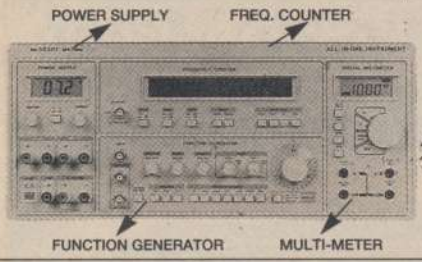

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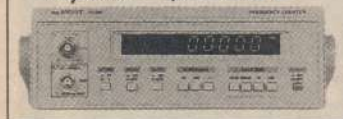

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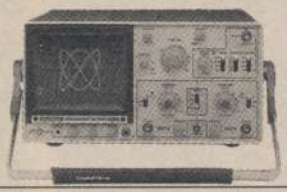

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Size: 3H x 1 7/8 W x 1 1/8 D Wt. 50z. BNC cnctrs.

Interference Filter MPIF $59.00

Filters interference from TV, FM broadcast, Paging and Cellular.
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Wide Coverage Base Antenna DA300 $99.50

25-1200MHz RX. TX or RX. 37" high. N adaptor with 50 ft. of cable to BNC adaptor.

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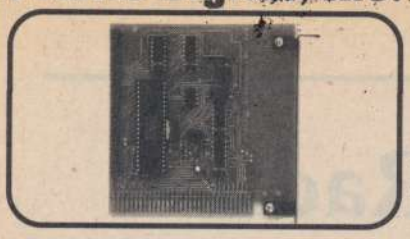
Prairie Digital, Inc.



PC DATA ACQUISITION SYSTEM - $79

INCLUDES SOFTWARE ON 5.25" FLOPPY MODEL 30-FOR 386'S, XT'S, AT'S, PS2 MODEL 25 & 30'S.

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MODEL 70 18 BIT (5.5 DIGIT) A/D WITH RS232 INTERFACE $239

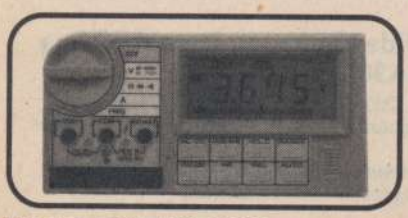
INEXPENSIVE - Equivalent resolution of 51/2 digit DVMs costing over $1000! FAST -- 16.7 to 133 ms/conversion depending on resolution and mode

MULTI-CHANNEL CAPABILITY - Up to 32 model 70's can be daisy chained together off of 1 serial port

SOFTWARE - Virtual instrument software features easy pull down menus, mouse support, CGA, EGA, VGA support. Will log to screen, printer, or disk data file for easy import to spreadsheets and graphic programs. Source code included (QuickBasic)

$239 COMPLETE (- Includes software on floppy, PC cable, 9 volt wall mount power supply and manual)

$199 WITHOUT - Software and cable



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INCLUDES RS232 PC CABLE AND SOFTWARE ON 5.25" FLOPPY

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- ★ DIODE TEST AND AUDIBLE CONTINUITY

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CIRCLE 49 ON FREE INFORMATION CARD

Motorless Motion!

Connect Muscle Wires™ to a battery or other power source and watch them *contract in length up to five percent!* Remove power, and they relax and are ready for millions more cycles.

Create direct linear action without heavy gears, coils, or motors. Use Muscle Wires in robots, models, planes, railroads – anywhere you need small, strong all-electric *motion.*

Q&A

What Are Muscle Wires?

Muscle Wires are highly processed strands of a nickel–titanium alloy called *nitinol.* At room temperature they are easily stretched by up to 5% of their length. When conducting an electric current they heat and return to their original "unstretched" shape with a force thousands of times their own weight.

How strong are Muscle Wires?

The force a wire pulls with varies with size, from 35 to 330 grams. For more strength, use several wires in parallel.

How fast can Muscle Wires activate?

They contract as fast as they are heated – as quickly as 1/1000 of a second. To relax, the wire must cool again. Rates of many cycles per second are possible with active cooling.

Flexinol *Muscle Wire* Specifications

Wire Diameter	50 µm	100 µm	150 µm
Resistance	510 Ω/m	150 Ω/m	50 Ω/m
Contract Force	35 grams	150 grams	330 grams
Typical Current	50 mA	180 mA	400 mA

How much power do Muscle Wires need?

Power varies with wire diameter, length, and surrounding conditions. At room temperature typical currents range from 50 to 400 mA. Power levels can be higher, but once the wire has fully shortened, power should be reduced to prevent overheating.

What are the advantages of Muscle Wires?

Muscle Wires have many advantages over motors or solenoids including small size, light weight, low power, very high strength-to-weight ratio, precise control, AC or DC activation, long life and direct linear action.

All these topics plus 14 great projects are covered in detail in our book. *Order Today!*

Get our new 96 page Book and Muscle Wire Sample Kit. It has 20 cm of 50 µm, and 40 cm each of 100 and 150 µmdiameter Muscle Wires (1 meter total), plus crimps & instructions – everything you need to *get moving* today!

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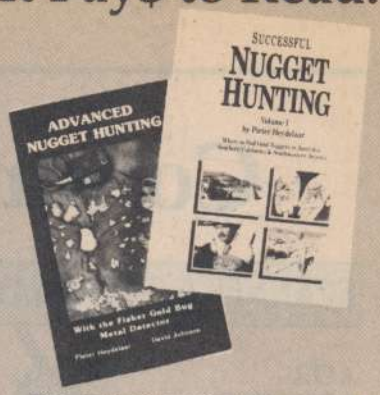

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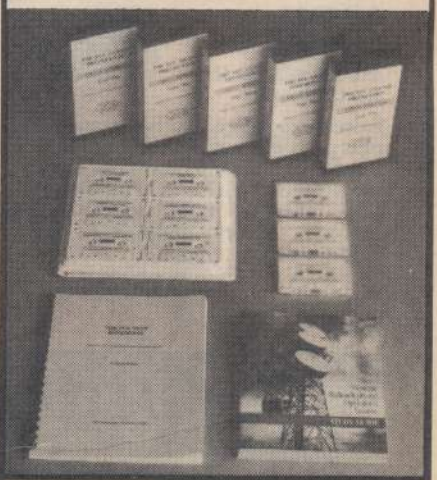

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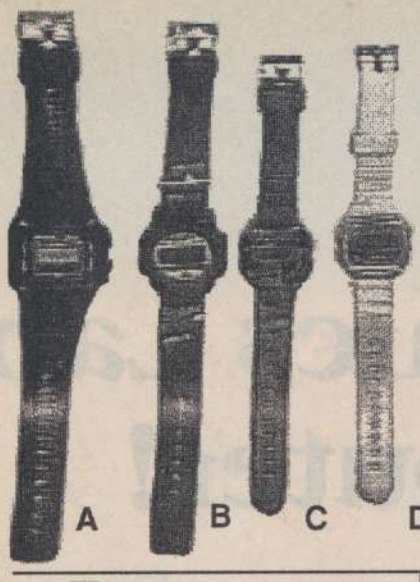

WE'VE GOT SOME TIMELY BARGAINS!

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C - Men's 5-function watch with "camouflage" face.
D - Women's 5-function watch, different colors.
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STK011 6.5W AUDIO POWER BLOCK
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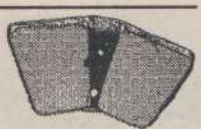

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50Ω 20W STRIPLINE RESISTOR
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EC103A SCR
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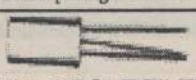
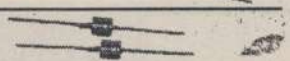
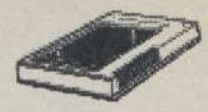


14 MHz 2-POLE FILTER
BW = 4 KHz, -3 dB.
$4.95 each

2 - 9 pF TRIMMER CAP
7 for $4.95



7 A, 1600 V DIODE
100 for $19.95



SCANNER PACKAGE!
386DX 20 MHz system, 3 MB RAM, 360K 5.25" floppy, 20 MB hard drive, Hercules-compatible mono monitor, Canon flatbed scanner with JLaser AT-3 interface, with drivers and software. **$899.00**

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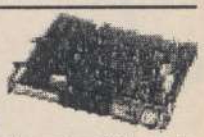

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These defective units contain many useful parts including a 950-1450 MHz tuner, two NEC 5150 gain blocks, filters. etc. **$24.95**

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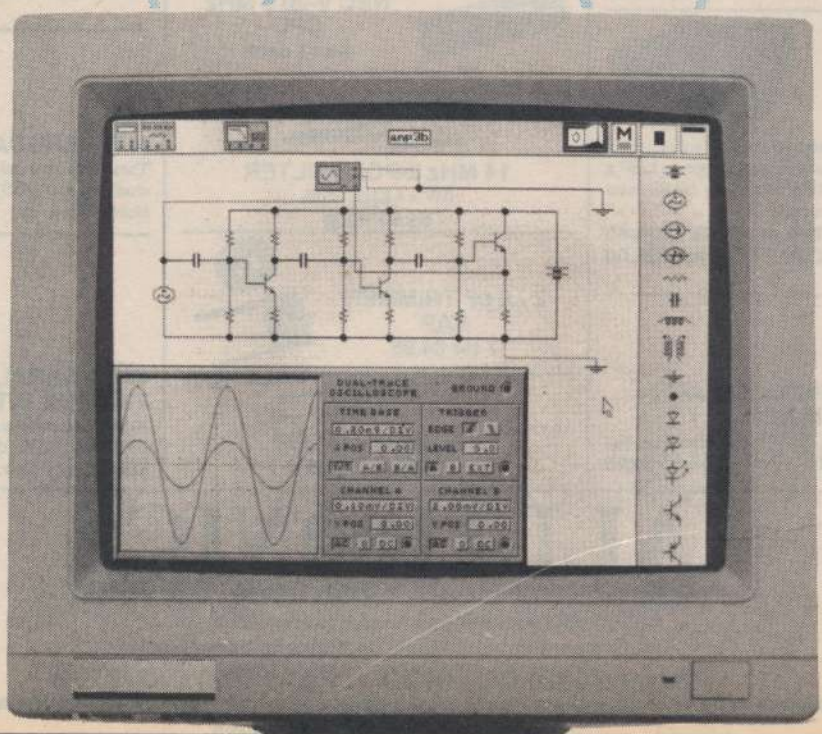
The Electronics Lab in a Computer!



Testing an analog three-stage amplifier with the simulated oscilloscope.

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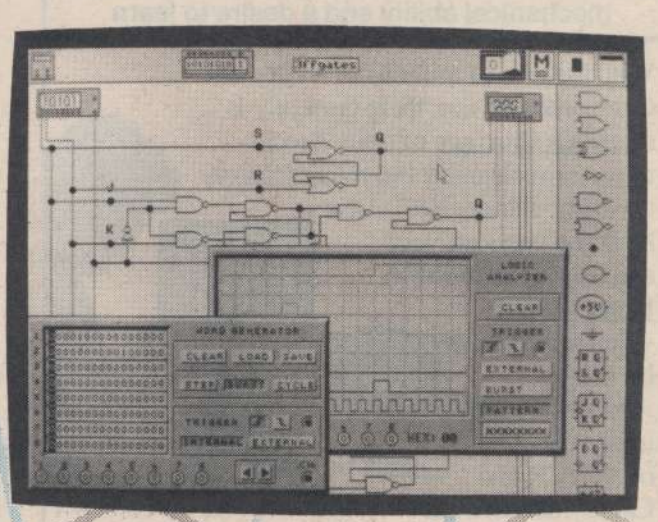
Powerful software to build and simulate analog and digital circuits.

Building and testing circuits is fast and easy with *Electronics Workbench.* Just click-and-drag with a mouse to add parts, run wires, and adjust instruments. The traces on the simulated instruments are the same as you'd get on real equipment.

Electronics Workbench really *is* an electronics lab in a computer. It's ideal for learning about electronics, experimenting, and prototyping circuits.



Testing a gate implementation of three different flip-flops.

Includes:

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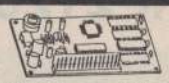
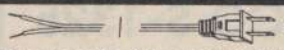
Digital Voice Module



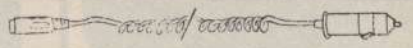
Ming# DVM-108. Digital recording module especially suited for reproducing verbal messages. Ideal for HAM contesting, memo recorder, verbal alarm system etc. Requires a minimum of external wiring. Up to 8 different phrase channels. Built-in 200 mW audio amp. 1 Megabit of DRAM memory, for up to 32 seconds of recording. Condenser or dynamic mike input. Board size: 3 3/4" X 2" X 1" high. Includes memory chips which require installation. Microphone and other external components not included.
CAT# DVM-108 $25.00 each

A.C. Line Cord



6' Black 18/2 A.C. power cords. SPT-1 insulation. Polarized plug.
CAT# LCAC-7 2 for $1.00 • 100 for $45.00 • 1000 for $400.00

Car Lighter Coil Cord



Automotive cigar lighter plug with replaceable 5 amp fuse. Quality, retractable coil cord extends to approximately 6 feet. Terminates with a 5 pin DIN plug which can be cut-off. Ideal for battery charger or running 12 Volt devices from car battery. **CAT# CLP-18** $1.50 each • 10 for $12.50

Piezo Element

3 Wire Piezo Element. Taiyo Yuden Co. # CB35BBKR4. Self-excited piezo electric diaphram. 1.40" diameter x 0.021" thick. Resonant resistance: 400 ohms. 5" color-coded leads.
CAT# PE-12 $1.00 each
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L.E.D.'s

Surface mount LED chip.

Clear when off, green when lit. Very tiny - whole unit is 0.115" X 0.055" X 0.05" thick. 1mm (0.04") lens diameter. Gold-plated mounting surfaces for superior conductivity.
CAT# SMLED-2 10 for $2.00
100 for $18.00
1000 for $140.00

Standard JUMBO

Diffused T 1-3/4 size (5 mm)

RED **CAT# LED-1**
10 for $1.50 • 100 for $13.00
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YELLOW **CAT# LED-3**
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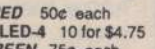
REDUCED PRICES FLASHING LED

W/ built in flashing circuit 5 volt operation. T 1-3/4 (5mm)

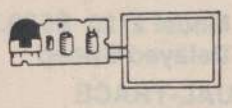


RED 50¢ each
CAT# LED-4 10 for $4.75
GREEN 75¢ each
CAT# LED-4G 10 for $7.00
YELLOW 75¢ each
CAT# LED-4Y 10 for $7.00

LED HOLDER

Two piece holder.
CAT# HLED
10 for 65¢

ELECTROLUMINESCENT BACKLIGHTS



At last! A low cost electroluminescent glow strip and inverter. These brand-new units were designed to backlight small LCD TVs made by the Citizen Watch company. The inverter circuit changes 3 or 6 Vdc to approximately 100 Vac, the voltage required to light the glowstrip. Luminescent surface area is 1.7" X 2.25". The strip is a salmon color in its off state, and glows white when energized. The circuit board is 2.2" X 1". Glow strip and circuitry can be removed easily from plastic housing. Ideal for special lighting effects.

Citizen# 92TA operates on 3-6 Vdc
CAT# BLU-92 $3.50 each
LARGE QUANTITY AVAILABLE
10 for $32.00 • 100 for $275.00

D.C. Wall Transformers (120 Vac INPUT)

Volts	Amps	Plug Style	Center	Cat#	Price
4 Vdc	70 ma.	2.5 mm co-ax	negative	DCTX-470	$2.00
6 Vdc	300 ma.	2.1 mm co-ax	positive	DCTX-632	$2.75
8.3 Vdc	10 ma.	battery snap		DCTX-8310	$1.50
9 Vdc	300 ma.	2.1 mm co-ax	positive	DCTX-932	$3.00
12 Vdc	100 ma.	2.1 mm co-ax	negative	DCTX-1210	$2.50
12 Vdc	500 ma	2.1 mm co-ax	negative	DCTX-125	$4.50
12 Vdc	800 ma.	2.5 mm co-ax	positive	DCTX-1281	$5.25
12 Vdc	1 Amp	none		DCTX-121	$6.50
14 Vdc	700 ma.	1.3 mm co-ax	negative	DCTX-1470	$5.25
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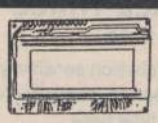

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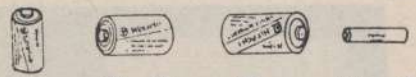

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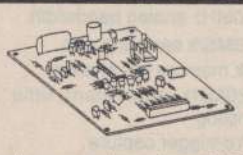

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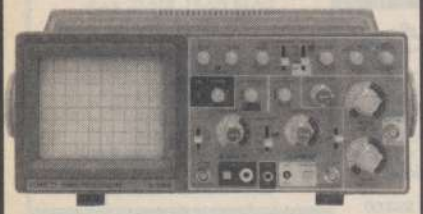

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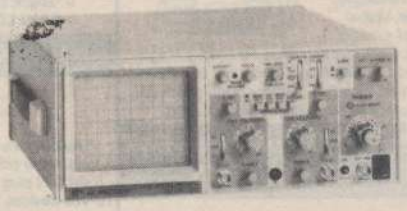

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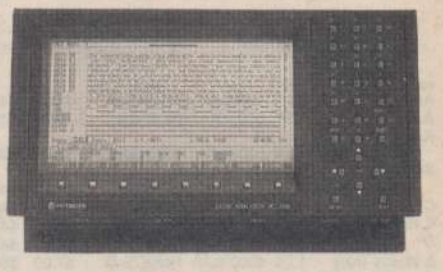

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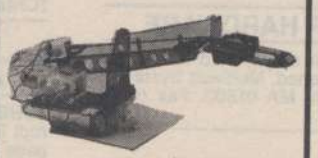

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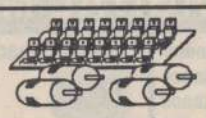
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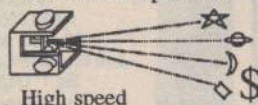
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Dissipation factor indicates leakage in capacitor and Q factor in inductor
Zero adjustment to reduce parasitics from test fixture
Very good for high frequency RF and surface mount components.

LCR Meter 195 $119.95

Very popular LCR

Inductance:1µH-200H
Capacitance:0.1pF-200 µF
Resistance:0.01Ω-20MΩ
Basic accuracy:R:1%, C:2%, L:3%
Test frequency 1 kHz

Capacitance Meter 7705 $57.95

0.1 pF-20,000µF in 9 ranges
0.5% basic accuracy
Zero adjustment ± 20pF to compensate parasitics from test fixture

Also Available:
Heavy duty DMM
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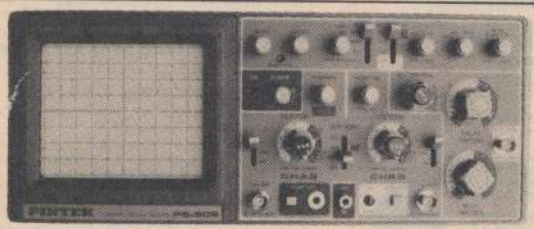

20 MHz Oscilloscope with Delay Sweep PS-205 $429.95

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PS-200	20MHz	DUAL TRACE	$339.95
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20 MHz Digital Storage Oscilloscope DS-203 $769.95

Switchable between digital and analog
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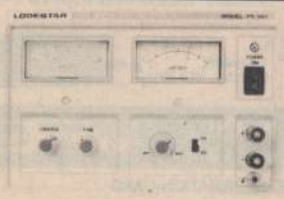

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Short circuit and overload protected

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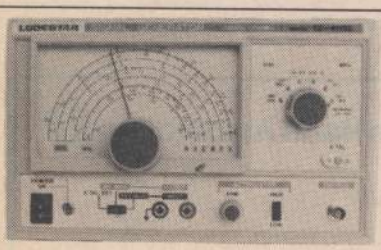

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100 kHz-150MHz sinewave in 6 ranges
Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz modulation

AUDIO GENERATOR AG-2601A $124.95

10Hz - 1MHz in 5 ranges
Output: 8Vrms sine, 10Vp-p squarewave
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Output distortion: 0.05% 500Hz - 50kHz
0.5% 50Hz - 500kHz
Output impedance: 600 ohm

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Frequency counter 1Hz-150MHz
Sensitivity <50mV
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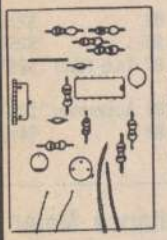

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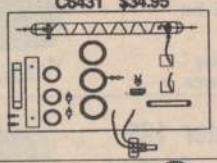

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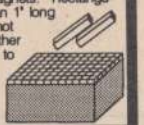

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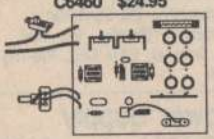

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TA-3600 ▲▲▲

Kit: $85.00
Assembled & Tested: $110.00

Power output: 300 watts RMS into 8 ohms. 540 watts music power into 8 ohms • Frequency response: 10Hz to 20KHz • Total harmonic distortion: Less than 0.05% • Intermodulation distortion: Less than 0.05% • Sensitivity: 1 V rms at 47K • Power requirements: 60 to 75 VDC at 8 amp • Dimensions: 8"x7¼"x2¼"

120W MOSFET POWER AMPLIFIER (MONO)

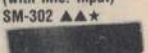
TA-477 ▲▲

Kit: $68.00
Assembled & Tested: $85.00

T. H. D.: Less Than 0.007% • Power output: 120 watts into 8 ohms RMS • Frequency response: 8Hz to 20KHz, +0-0.4 dB • Sensitivity: 1V • Power requirements: 55 VDC @ 3 amps. May use Mark V Model 003 Transformer.

60W + 60W Stereo Power Amplifier (with Mic. input)

SM-302 ▲▲★



Kit: $73.00
Assembled & Tested: $85.00

Frequency response: 20Hz to 20KHz • Total harmonic distortion: < 0.1% • Power output: 60W per channel into 4 ohm load • 33W per channel into 8 ohm load • Input sensitivity: Mic 10mv • Hi 380mv • Lo 640mv • Signal to noise ratio: Better than 70 dB • Power consumption: 100W. Dimensions: 360 mm x 75 mm x 200 mm.

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SPECIFICATIONS
Input sensitivity (music mode): 100mV. (music+program): 2V • Output power: 1170W per channel MAX. 4680 W total • Power requirements: 105-120V, 60Hz • Dimensions: 14.32" wide, 9" high, 3.19" deep.

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TA-1500 ▲▲▲

Kit: $73.70
Assembled & Tested: $95.81

Power output: 80 watts per channel into 8 ohms 100 watts per channel into 4 ohms • Total harmonic distortion: Less than 0.03% • Frequency response: Aux input: 5 to 50,000 Hz+0.2dB, -2dB • Frequency response: Power amplifier section: DC to 200KHz • Sensitivity: Phono: 2.5 mV @ 47K Aux: 150 mV @ 47K Mic: 6 mV @ 10K Output: Tape: 150 mV @ 47K Preamp: 1V @ 60C ohms • Power transformer: 26V to 32V AC x 2 @ 6 A (Mark V Model 001) • P.C. Board Dimensions: 10.5 x 6.13 x 2.25 • Heat sink: 5.13 x 2.63 x 3" (Each) Use rack mount cabinet LG 1924 or LG 1925.

80W + 80W PURE DC STEREO MAIN POWER AMPLIFIER

TA-802 ▲▲

Kit: $45.94
Assembled & Tested: $59.72

Power output: 80 watts per channel into 8 ohms • Total harmonic distortion: Less than 0.05% at rated power • Intermodulation distortion: Less than 0.05% at rated power • Frequency response: DC to 200KHz. -0 dB. -3dB. @ 1 watt • Power requirements: 30 VAC x 2 @ 6 amp. May use Mark V model 001 transformer P. C. Board: 8-1/2" x 5" x 1-1/8" Heat sink: 5-1/8" x 2-5/8" x 3" (Each)

VIDEO/AUDIO SURROUND SOUND PROCESSOR

SM-333 ▲▲▲★

Kit: $73.00
Assembled & Tested: $85.00

Frequency response: 20Hz to 20KHz • Total Harmonic distortion: Front channel: 0.05%. Rear channel: Less than0.25% • Input signal voltage: 0.1 to 3.5V • Output: Front channel: 0.1 to 3.5V • Rear channel: 6.6V • Delay time: 5 to 50 milliseconds • Input impedance: 47K • Power requirements: 100-120 VAC, 60Hz • Dimensions: 14.2" wide, 4.82" deep, 2.1" high.

120W + 120W AC/DC STEREO HI-FI & PA AMP.

SM-720 ▲▲

SPECIFICATIONS
Output Power: 120W x 2 (P.M.P.O.)
Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV
Tone Control: Treble ± 8dB • Bass ± 8dB
Frequency Response: 20Hz-20KHz
Power Requirements: AC110/60Hz • DC12-16V
Dimensions: 10-5/8"x8-1/8"x3-1/8"(W x D x H)

Kit: $75.00
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BY VINCENT VOLLONO

Build a VOICE DISGUISER

Have loads of fun fooling friends and family when they call with this simple frequency-shifting circuit

We often take for granted that our identity can be verified by our voice. How many times do we receive phone calls, and just by the sound of the persons voice know who it is without having the person identify themselves. Wouldn't it be fun if we could change our voice from time to time? Well, with the *Voice Disguiser* described in this article, it is possible to electronically change the sound of your voice to the extent it can not be recognized.

The Voice Disguiser does not muffle or filter your voice, instead it actually shifts the frequency spectrum of your voice higher or lower. The Voice Disguiser is designed to be used over a telephone or a public address system, however, it can also be used by itself. To couple the altered voice to the phone line, the telephone receiver is placed near the Disguiser's speaker.

You can use the Voice Disguiser to hold confidential conversations without revealing the identity of the participants or to play tricks on your friends. You can also use it to answer your phone when you don't want to reveal your identity.

General Description. Figure 1 shows a block diagram of the Voice Disguiser. The circuit is comprised of a microphone, audio amp, two oscillators (one fixed at 4 kHz and the other variable up to the same frequency), two 5-kHz low-pass filters, two modulators, an output amp, and a speaker.

The microphone picks up your voice (converting it into an electrical signal) and feeds it to the audio amplifier, which boosts the input to a usable level. From there, the signal is output to the first modulator, where it is frequency modulated with the output of the first 4-kHz oscillator. The signal is then fed through the first low-pass filter, which passes signal frequencies of 5 kHz or less, stripping the high-frequency components from the modulated signal.

From there the signal is fed to the second modulator, where the modulated, low-pass filtered signal is frequency modulated with the output of the variable 4-kHz oscillator. The output of that modulator is then fed through the second low-pass filter (with the same results as produced by the first) to the audio-output amplifier, where its power is boosted and sent to the speaker.

Getting into Details. A complete schematic diagram of the Voice Disguiser, which is a lot less complicated than it might appear, is shown in Fig. 2. Microphone MIC1 picks up the voice signal and feeds it to an audio amplifier, consisting Q1 and Q2, and a few support components. The amplifier has a low-pass gain response that limits the voice frequencies to 5 kHz or lower.

The voice signal is then fed to the input of the first balanced modulator, which is comprised of U1-a, U1-b, U2-a, and U3-a. The output of the first 4-kHz oscillator, built around U3-f and U3-e, is fed to the carrier input of the first modulator. The frequency of the first oscillator is controlled by the setting of potentiometer R13. The modulator output—a double-sideband suppressed-carrier signal centered on 4 kHz—is then filtered by the first 5-kHz low-pass filter, formed by U2-b, which eliminates the upper-sideband signals.

Note that at this point, the voice-frequency spectrum is inverted (*e.g.*, the frequencies that were low now become high, and vice versa), making the voice signal completely unintelligible. That means that it is now necessary to reverse the modulation process to recover the voice signal and make it intelligible again. To do that, the output of the first low-pass filter is fed to a second modulator formed by U1-c, U1-d, and U3-b, where it is frequency modulated with the output of the second carrier oscillator, comprised of U3-c and U3-d; the frequency of the second oscillator is controlled by potentiometer R36.

The output of the second modulator is filtered by the second low-pass filter, which consists of U2-d and few support components, and amplified by Q3. The voice output signal from Q3 is fed to U4 (an LM386 low-voltage,

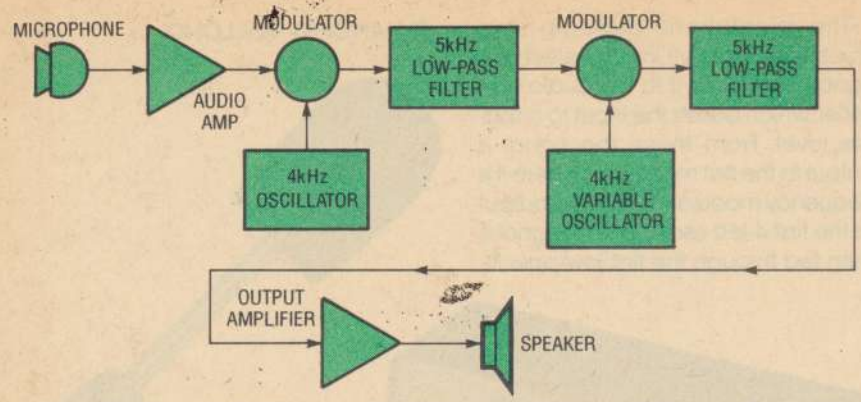


Fig. 1. As shown by this functional block diagram of the Voice Disguiser, the circuit is comprised of a microphone, audio amp, two oscillators (one fixed at 4 kHz and the other variable up to the same frequency), two 5-kHz low-pass filters, two modulators, an output amp, and a speaker.

PARTS LIST FOR THE VOICE DISGUISER

SEMICONDUCTORS

U1—4016 CMOS quad bilateral switch, integrated circuit
U2—MC3403 quad op-amp, integrated circuit
U3—4069 CMOS hex inverter, integrated circuit
U4—LM386 low-voltage, audio-power amplifier, integrated circuit
Q1–Q3—PN2222 general-purpose NPN silicon transistor
LED1—Light-emitting diode

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1, RJ2, R25—10,000-ohm
R2, R7—15,000-ohm
R3—68,000-ohm
R4, R18, R28—2700-ohm
R5—120-ohm
R6—56,000-ohm
R8, R34—1000-ohm
R9—1000-ohm potentiometer
R10, R11, R23, R24—100,000-ohm
R13—10,000-ohm PC-mount potentiometer
R14, R35, R37—5600-ohm
R15—220,000-ohm
R16, R26—680-ohm
R17, R27—9100-ohm
R19, R29—150,000-ohm
R20, R30—8200-ohm
R21, R31—27,000-ohm
R22, R32—1500-ohm
R33—10-ohm
R36—10,000-ohm potentiometer
R38–R41—3300-ohm
R42—2200-ohm

CAPACITORS

C1, C3, C7, C12, C15, C21—10-μF, 16-WVDC, electrolytic
C2, C5 C22–C25—0.47-μF, 16-WVDC, electrolytic
C4, C6, C8, C9, C10, C17—0.005-μF, ceramic-disc
C11, C13, C19, C20—0.05-μF, ceramic-disc
C14, C16, C18—0.01-μF, ceramic-disc
C26—0.001-μF, 50-WVDC, Mylar
C27—100-μF, 50-WVDC, Mylar
C28—4.7-μF, 35-WVDC, Mylar

ADDITIONAL PARTS AND MATERIALS

S1—SPST switch
B1—9-volt transistor-radio battery
SPKR1—4–8-ohm speaker
MIC1—Handheld microphone (see text)
T1—Audio output transformer
Perfboard materials, enclosure, AC molded power plug with line cord, battery(s), battery holder and connector, wire, solder, hardware, etc.

Note: The following parts for the Voice Disguiser are available from Xandi Electronics, P.O. Box 25647, Tempe, AZ 85285-5647; Tel. 602-829-8152 (general information and catalogs); 800-336-7389 (orders only). An etched and drilled printed-circuit board (part XV200B) is available for $15.95; a parts kit (part XV200K) containing all resistors (including potentiometers), capacitors, transistors, integrated circuits, and battery connector for $40.95. Please add $4.00 for shipping and handling. COD orders, add $6.00. Arizona residents please add 6.7% sales tax.

audio-power amplifier) through an impedance-matching transformer, T1. The output of U4 is then used to drive SPKR1 (an 8-ohm speaker). Note: U4 is optional. Although the unit will work without U4, the output will be low but more than sufficient for over-the-telephone use. If the amplifier is left out, capacitor C21 (in the emitter circuit of Q3) can be directly connected to a audio impedance-matching transformer (T1 as shown) and its output used to drive a 4- to 8-ohm speaker.

In operation, if both carrier oscillators are set to the same frequency, the voice signal from the speaker will be an exact duplicate of the input signal from the microphone. However, if the frequency of the second oscillator is varied (via R36), the output voice signal also shifts in frequency. That makes the voice reproduced by the speaker sound higher or lower pitched than normal.

Circuit Construction. The Voice Disguiser was built on a printed-circuit board, measuring about 3 13/16 by 2 7/16 inches. A template of that printed-circuit layout is shown in Fig. 3 for those of you who wish to etch your own board. Or, if you prefer, you can purchase a kit of parts (including a pre-drilled printed-circuit board) or the board alone from the supplier listed in the Parts List. Once you've etched or purchased your printed-circuit board and gathered all the parts listed in the Parts List, assembly can begin.

IC sockets should be provided for U1–U3; besides serving as a circuit-board marker (allowing you to easily locate the proper positions of the support components), they also keep the IC out of harms way (soldering-iron heat) and allow you to make quick and easy replacements should that ever become necessary.

Figure 4 shows the parts-placement diagram. Start by mounting and soldering the IC sockets to the board. Next, install the resistors and capacitors. Be careful that the electrolytic units are properly oriented. After that, carefully install the transistors (Q1–Q3), making sure that they are properly oriented. Once all of the on-board components have been installed, connect short lengths of hook-up wire to the appropriate points on the circuit board for connection to the off-board components.

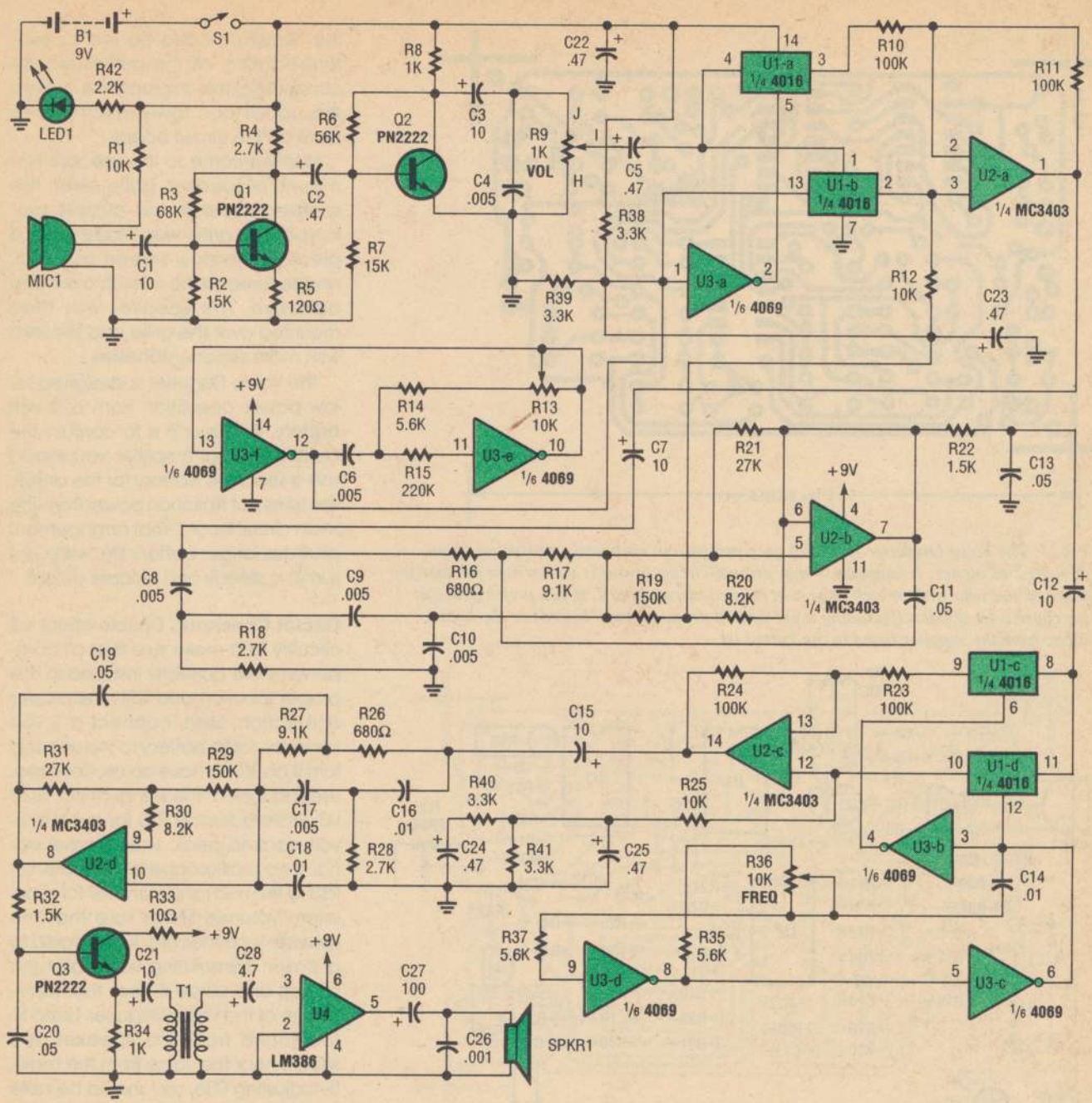


Fig. 2. Although, it might appear otherwise from this schematic diagram, the Voice Disguiser is not very complicated. Note: The LM386 low-voltage, audio-power amplifier (U4) is optional and was added to the main circuit to increase the circuit's output power. It may be left out of your project if desired, however, without it the output volume of the circuit will be greatly reduced.

You will note that the parts-placement diagram shown in Fig. 4 contains no previsions for U4—the LM386 audio-power amplifier, which is optional—or its support components (C26–C28), nor does it have provisions for the audio transformer, T1. If the amplifier is included in your project, it and its associated components can be wired together on a small section of perfboard, along with T1, and connected to the main circuit board through short lengths of hook-up wire. Although an LM386 amplifier was used to boost the main circuit board's output power, any other type of amplifier can be used to boost the output power of the Voice Disguiser. Be careful when wiring the power amplifier, it's easy to mis-wire those components; in fact, it's wise to double (or even triple) check your work to ensure that the circuit contains no errors.

In any event, once your project board(s) are completed, prepare the enclosure that will house the circuit board(s). The author's unit was housed in a plastic project box with a metal lid, measuring about 6¼ × 3¾ × 2 inches. It will be necessary to drill holes in the lid of the enclosure for LED1, S1, R9, and R36, and to make a cutout for SPKR1. It will also be neces-

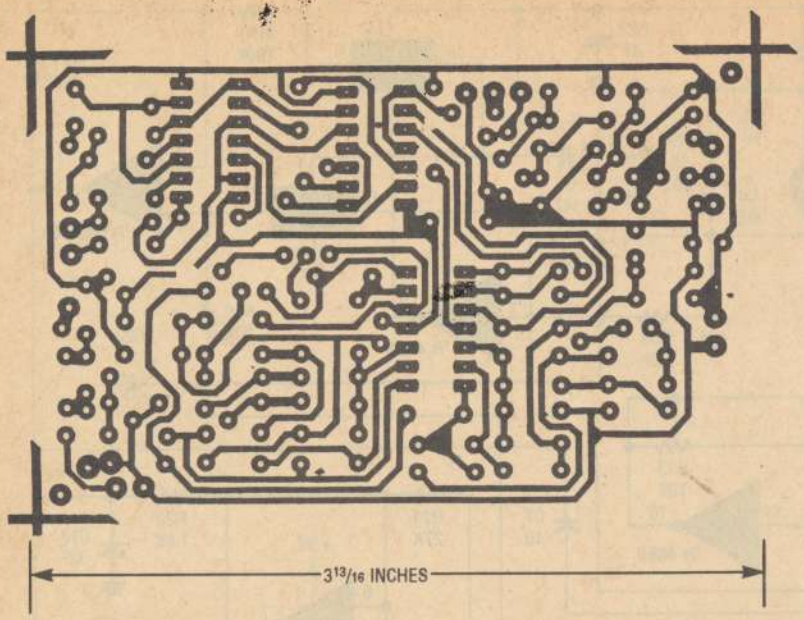


Fig. 3. The Voice Disguiser was built on a printed-circuit board, measuring about 3 13/16 by 2 7/16 inches. A template of that printed-circuit layout is shown here full size for those of you who wish to etch your own printed-circuit board. If you prefer, you can purchase a kit of parts (including a pre-drilled printed-circuit board) or the board alone from the supplier listed in the Parts List.

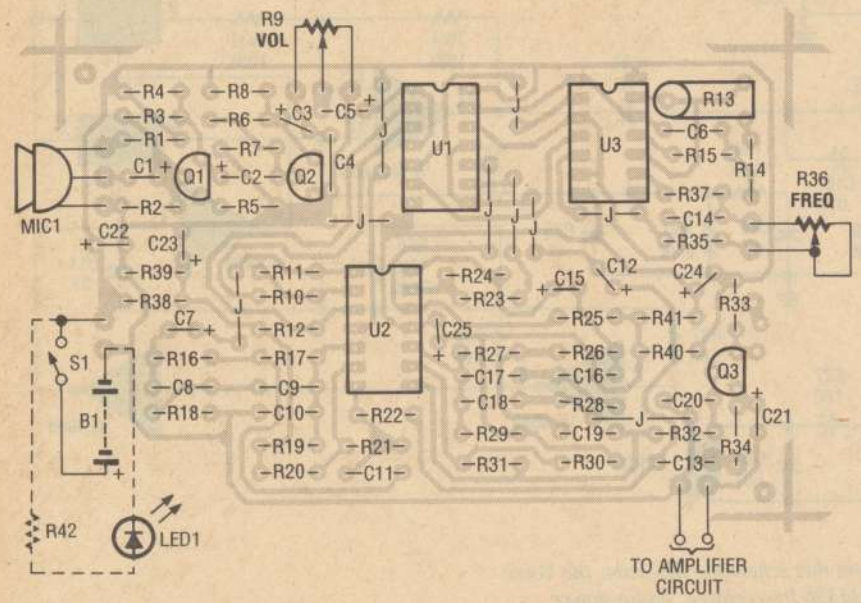


Fig. 4. Here is a parts-placement diagram for the author's printed-circuit layout. You will note that the LM386 amplifier is conspicuously absent from this parts-placement diagram. Also missing are the amplifier's support components (C26–C28), and ditto for the audio transformer (T1).

sary to drill a hole in the side of the enclosure through which to feed the microphone cable. Once all of the holes have been drilled, mount and connect the off-board components and amplifier circuit (if used) to the appropriate points on the printed-circuit board. Note that there is no dedicated connection point on the board for LED1 or R42, the current-limiting resistor for the LED. Those components were instead connected from battery ground to the "on" side of S1 (the power switch) as shown.

Where the microphone is concerned, the author used one taken from an old video camera. However, you can use just about any microphone that you happen to have on hand. Although the microphone is shown (both in Fig. 2 and Fig. 4) as being a three-terminal (or wire) unit, the circuit can also be fed by two-terminal unit, as the author did, by connecting the microphone wire to the upper and lower microphone pads on the circuit board.

Next we come to the speaker. First mount a speaker grille over the speaker cutout. In the author's prototype, the grille was made from a piece of window-screen material, and secured to the lid with a silicone adhesive. The speaker was then mounted over the grille and secured with more silicone adhesive.

The Voice Disguiser is designed for low-power operation from a 9 volt battery. If your unit is to contain the optional output amplifier, you should use a separate battery for the amplifier, so as not to siphon power from the main circuit board. That arrangement provides longer battery life, while ensuring a steady and reliable output.

Circuit Checkout. Double check all circuitry and make sure that all components are correctly installed in the proper location and with the proper orientation. Next, connect a 9-volt transistor-radio battery to the unit and turn it on. If you have an oscilloscope, use it to look at the signal at pin 12 of U3, while adjusting R13 for a 4-kHz, 8-volt peak-to-peak, squarewave signal. If no oscilloscope is available, set R13 to the mid range and R9 for maximum volume. Make sure that the speaker is connected. Tune a radio to a station transmitting voice only (no music), and place it near the microphone of the Voice Disguiser. Listen to the sound from the speaker. You should hear the voice from the radio. By adjusting R36, you should be able to shift the pitch of the voice.

Although the maximum audio from the speaker (without the optional audio amplifier) may not be very loud, it provides more than enough volume to drive the transmitter of almost any telephone.

Note that if you are planning to use the Voice Disguiser to transmit over the telephone, it would be best to keep the speaker of the Disguiser right up against the telephone and keep the handheld microphone away from the phone. The reason being is that if the microphone is too close to the telephone, your regular speaking voice will be also picked up by the telephone microphone. ■

Don't fret, we take a refreshingly different and intuitive approach to explain how an op-amp functions.

BY ROBERT DOUGHERTY

Not Another Op-Amp Article!

I recently saw an article in an electronics-hobbyist magazine that proported to explain how op-amps work. The article began with a "plain-vanilla" explanation of what an op-amp does, mentioned that the term "op-amp" was a contraction of "operational amplifier," and that the term "operational" referred to mathematical operations (*oh, wow*). The article contained about a dozen tiny schematics showing the various ways an op-amp could be hooked-up. Each schematic included a formula for calculating the circuit's gain and was accompanied by a terse explanation of the circuit. The article closed with comments about how useful op-amp's are and suggesting that further study would bring rich cultural rewards. Shoot! That thing gave about as much information as the filler blurbs in the home section of the local newspaper ("... know your stock broker ... research the mutual fund before buying," etc.).

Once, while helping an acquaintance troubleshoot an amplifier, I found that, although he could calculate the values of the feedback and input resistors from textbook formulas, he had very little (I'm being kind—he actually had no) understanding of what was actually taking place in the circuit. He was, for example, puzzled by the lack of a signal at the inverting input of the device.

In trying to explain, in clear, simple terms what was happening in his circuit, I discovered gaps in my own understanding. What he and I needed was a clear, simple tutorial describing what each component in the circuit did and how they work together to get the desired effect. It occurred to me that there are probably a lot of people in the same boat; hence, this article. I'll proceed to simply describe op-amp operation under the assumption that you know what an op-amp is for; know how to calculate voltage, current, and resistance using Ohm's law; and want to know more about how op-amp circuits actually work.

The Voltage Divider. Consider the voltage divider in Fig. 1 made up of two 100k, resistors and a +10-volt source at the one end and −10-volt source at the other end. Naturally, there is current flow through the voltage divider from the +10-volt side to the −10-volt side. Of course, Ohm's law will give you the current flow thru the network and the voltage drop it produces across each resistor. As the two resistors are the same value and the same current flows through each, each one drops the same voltage. The voltage at the junction is therefore zero volts. That point is called a "virtual ground" because it is not actually hardwired to the circuit ground, but a voltmeter between this point and the actual circuit ground will read zero volts.

You could change some of the characteristics of the circuit and still have a virtual ground. For example, if the two resistors were 10k rather than 100k, we would still have zero volts at their junction. The only difference is that the current would be ten times what it was with 100k resistors. Also, if we change the voltages to plus and minus 5 volts, we would still have zero volts at the junction of the two resistors. Even if we switch the polarity of both of the voltages, we would still have zero volts at the junction of the two resistors. The only difference in the circuit is that the current would flow the other way.

For the sake of discussion, keep firmly in mind that if we have a voltage divider made of two identical resistors and place complementary (positive and negative) voltage sources at each end, it will produce zero volts at the junction of the two resistors. Note that the resistors are labeled R_i and R_f, which stand for "input resistor" and "feedback resistor," respectively. The meaning of those labels will become clear as we proceed.

The Amplifier. The standard symbol for an op-amp is shown in Fig. 2. Op-amps have two inputs: an inverting input (labeled with a minus sign) and a non-inverting input (indicated by a plus sign). The signs on the inputs do not specify the voltage polarities applied to the inputs, they are just symbols used to distinguish the inputs from one another.

An op-amp responds to the inputs much like a comparator does: If the inverting-input voltage is greater than the non-inverting-input voltage, the output of the op-amp swings to the negative supply voltage; if the inverting input voltage is less than the non-inverting input voltage, the output of the device becomes positive.

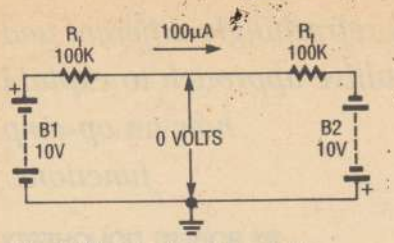


Fig. 1. The junction between the resistors in this voltage divider is a virtual ground. It is essentially at zero volts, but it is not directly wired to ground.

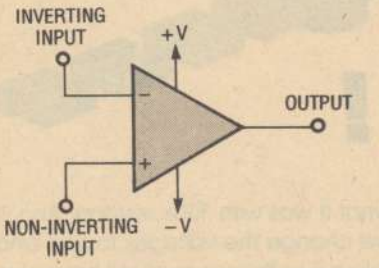


Fig. 2. Op-amps have two signal inputs: one inverting, the other non-inverting. They are denoted with a minus sign and a plus sign, respectively.

For the sake of discussion, let's consider what would happen if we connected the non-inverting input to a reference voltage—say zero volts from the actual ground—and applied −10 mV to the inverting input. The output of the op-amp would immediately go positive. That is, it goes to almost the positive supply voltage. The fact that the output of the op-amp is positive tells us that the inverting input is less (more negative) than the non-inverting input.

If we switch the voltage at the inverting input of the op-amp to +10 mV, the output of the op-amp would switch from the positive rail to the negative rail. The fact that the output of the op-amp is negative tells us that the voltage at the inverting input is greater (more positive) than that at the non-inverting input.

Putting it all Together. With the voltage divider presented earlier and op-amp operation in mind, we're ready to procede to the next step in our discussion: putting our voltage divider to work with an op-amp. The voltage divider back in Fig. 1 was drawn horizontally because that is how a resistor network would usually appear in an op-amp circuit schematic, such as the one in Fig. 3.

Note that we are no longer applying a discrete voltage source to R_f because the op-amp is acting as the source in the circuit. By design, the op-amp will place the correct voltage on R_f at the output to balance the voltage applied to R_i at the input in order to keep the voltage at the inverting input the same as the voltage at its non-inverting input (in this case zero volts or ground). As a by-product of that job, we get a voltage at the output of the op-amp that is a negative duplicate of the voltage at the circuit's input.

That configuration is called an "inverting" op-amp circuit with a gain of one. It is inverting because for a positive voltage input we get a negative voltage output from the circuit, and vice versa, and it has a gain of one because the amplitude of the input signal is equal to that of the output signal. If we put +10 volts in, we get −10 volts out. If we put in −5 volts, we get +5 volts out. If we put zero volts in, we get zero volts out.

Since the op-amp will strive to keep the voltage at its inverting input equal to the voltage at the non-inverting input, the voltage at the inverting input never seems to change. A voltmeter will read the same voltage at the inverting input as at the non-inverting input. That is true no matter what the input does. The input must, however, be limited to levels that keep the output between the supply voltages, less a couple of volts for headroom. If the op-amp's supply voltage is plus and minus 15 volts, then the op-amp could be expected to put out any voltage between about maybe plus and minus 12 volts.

What is actually happening is that when the input changes, say it goes a little bit lower, more negative, in voltage, the voltage at the junction of the two resistors is dragged a little bit lower. Remembering that when the inverting input goes negative, the output of the op-amp goes positive. The output of the amplifier rises.

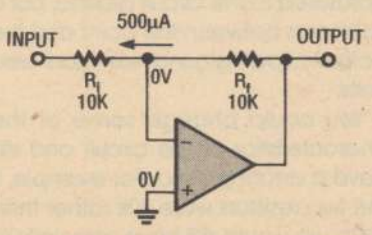


Fig. 3. When combined with a voltage divider network, the op-amp's output fills the role of B2 back in Fig. 1.

Now the junction of the two resistors also rises, goes through ground and becomes a little bit positive. As mentioned earlier, when the inverting input goes more positive than the non-inverting input, the output of the op-amp falls and the junction voltage also falls down through ground and becomes negative. The op-amp's output moves in the opposite direction to compensate; always trying to keep the inverting input at the same voltage, in this case zero, as the non-inverting input.

The "hunting" or dithering around zero is very small and fast. To all intents and purposes, the output is a reflection of the input. This hunting around a set value is characteristic of feedback systems. It continuously tries to correct the difference between the output and the reference, overshoots, and then re-compensates.

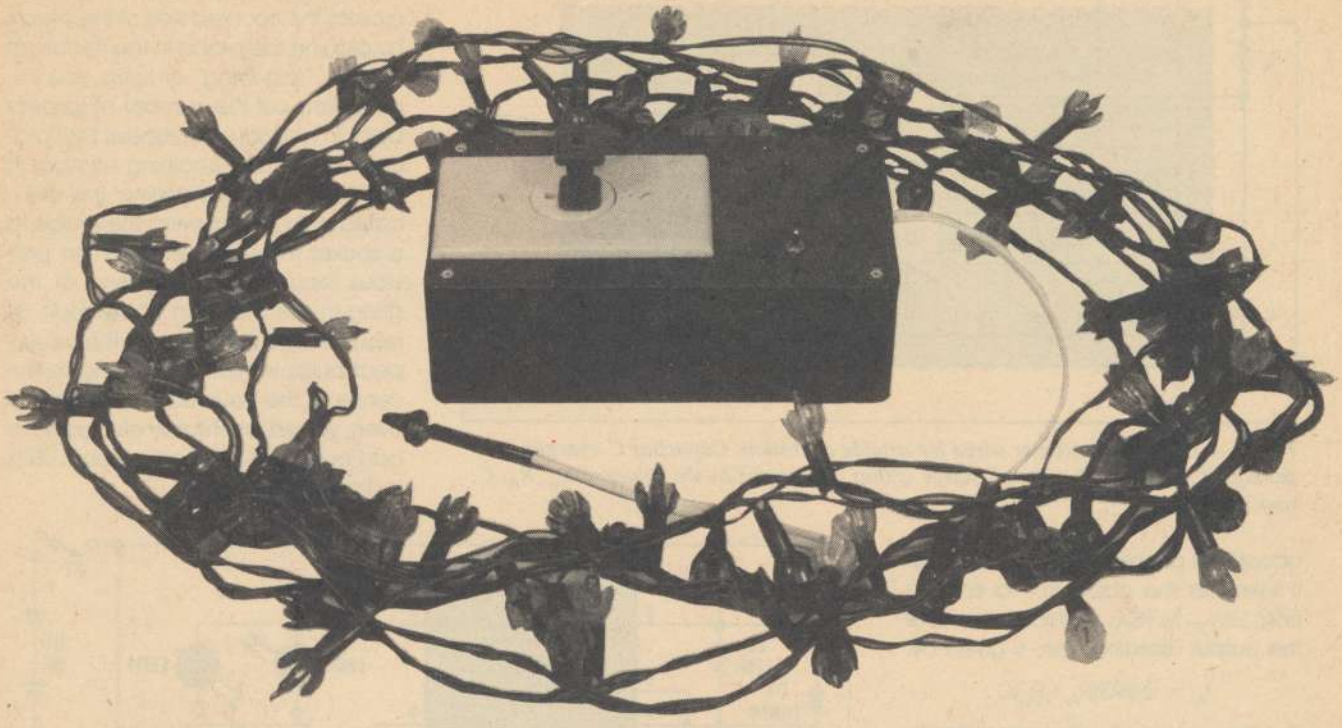
It is almost exactly the same as the hunting that your household heating system does. The temperature in the house falls below that set on the thermostat so the heater comes on. Once the temperature rises above that set on the thermostat the heater turns off, etc.

In order to obtain different gains from the circuit, you have to select the resistor values so that the output level must go to the input level times the desired gain of the circuit in order to produce the the zero-volt level that is required at the junction of the voltage divider.

Using a little common sense and Ohm's law, you can set the gain of the circuit almost anywhere you want. Just design the voltage divider so you get zero volts at the junction of the two resistors.

There you have it, how one op-amp circuit works. I know that the purists among you are going to scream because there are no formulas, my treatment of feedback is less than rigorous (rigor in treatment leads to *rigor mortis* in readers), and all I have treated is one circuit with no mention of input offsets, temperature compensation, or other exotica. Even so, I hope this has helped give you an intuitive understanding of the op-amp and how it works so that the next article on the subject you pick up will be somewhat easier to follow. ■

BUILD A



HOLIDAY-LIGHT TESTER

BY JOHN YACONO AND MARC SPIWAK

Christmas should be a time for peace and joy—not for wrestling with lights that don't light!

Many of you are probably familiar with what's involved in finding one burned-out light bulb in a long string of them. It's really frustrating when you have to pull each bulb and replace it with a known-good one, just to find the one bad one. And if you're lucky, you'll find the bad bulb and the string will come to life. If you're not lucky, there's a break in the wire somewhere in the loop, and you won't find it by checking the bulbs.

If you've ever had that problem, or if you regularly repair anything with many lights wired in series, then you'll certainly appreciate this neat little gadget: the *Christmas-Tree Light Tester*. It points you in the direction of the bad bulb by plugging into any socket in the string and seeing which of two LED's light up. Which LED lights depends on the direction from which power is being supplied to the LED's. Should you get to a point where the LED's indicate a change in direction then you know there's a break in the wire or a bad bulb somewhere between the two sockets just checked and you also know exactly where. The tester also comes in handy for testing strings of lights on vanity mirrors, stage props, and so on. Let's take a look at the circuitry that lets us do this.

A 555 Circuit. The tester circuit is based on a 555 oscillator/timer. However, the IC is used in a non-standard configuration, so let's consider how a 555 timer works in a more common circuit before seeing how it's used in our tester.

A 555 wired for astable operation is shown in Fig. 1. If you apply power to the circuit, capacitor C starts to charge through R_A and R_B, and the output is high. The FET in the 555 can initially be ignored as it is off. The rate of charge is thus determined by the values of R_A, R_B, C, and V_{CC}.

The resistor network composed of R_{11}–R_{13} divides the supply voltage (V_{CC}) into ⅓ V_{CC} and ⅔V_{CC} (called the "trigger" and "threshold" voltages, respectively). Note that both comparators (C1 and C2) monitor the voltage stored in the capacitor. Comparator C1 compares the capacitor voltage to the threshold voltage and C2 compares it to the trigger voltage.

When the capacitor charges to the threshold voltage, C1 momentarily goes high, toggling the flip-flop. That causes the internal FET to start draining the charge off the capacitor via R_B (without any of the discharge current flowing through R_A), and the output terminal goes low. The rate of discharge is thus determined by R_B, C, and V_{CC} (but not R_A). Once the capacitor voltage drops to the trigger voltage, C2 is triggered and toggles the flip-flop. The FET then turns off, the output goes high, and the capacitor begins to charge again.

There are a few interesting facts

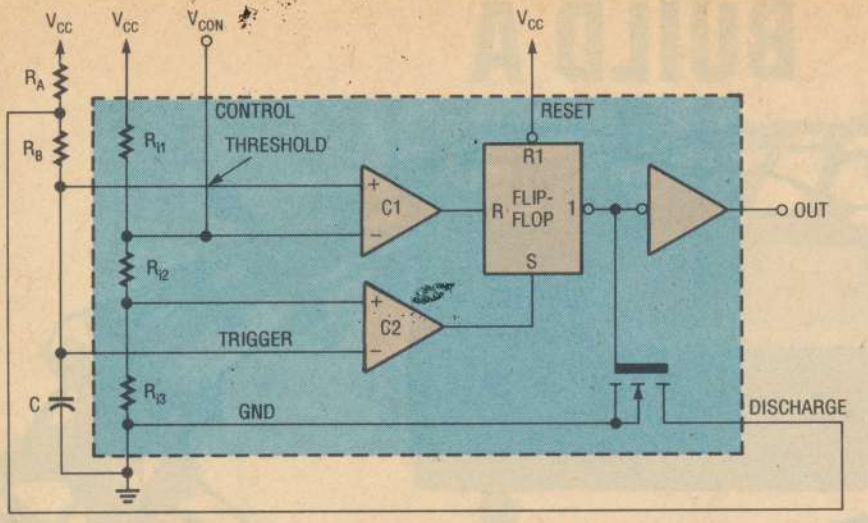


Fig. 1. A 555 oscillator/timer wired for astable operation. Capacitor C charges through R_A and R_B. The rate of charge is thus determined by the values of R_A, R_B, C, and V_{CC}.

about that process. First, the time that it takes for the capacitor to charge from $\frac{1}{3}V_{CC}$ to $\frac{2}{3}V_{CC}$, which is the time the output remains high, is given by:

$$t_h = 0.693(R_A + R_B)C$$

The time it takes for the capacitor to discharge from $\frac{2}{3}V_{CC}$ to $\frac{1}{3}V_{CC}$, which is also the length of time the output is low, is given by:

$$t_l = 0.693(R_B)C$$

Note the absence of R_A in the last equation. That's because only R_B is in the discharge path. That prevents us from attaining a 50% duty cycle (t_h can't equal t_l). Some may propose doing away with R_A, but that would short the power supply through the discharge pin at the beginning of the discharge cycle. However, there is another method for obtaining a 50% duty cycle—by putting a diode pointing down (cathode toward the capacitor) in parallel with R_B, and setting R_A equal to R_B. In that way, R_B is bypassed during charging, but it is still in the discharge path. That technique is used in our circuit, as you'll see in a minute.

The Tester. In the tester (shown in Fig. 2), a battery (B1) is the power supply for the circuit. The 555 oscillator/timer is connected to R1, R2, and C1 so that it produces a train of pulses at its output (pin 3), however its operation has been modified by the addition of D1 as described earlier. The reason for that will become clear as we proceed. The highs and lows produced by the 555 are applied to LED1 and LED2 via R3. The two LED's have been installed in the base of a Christmas bulb (in place of the incandescent bulb) so that the free end of each LED replaces one of the evicted bulb's contacts.

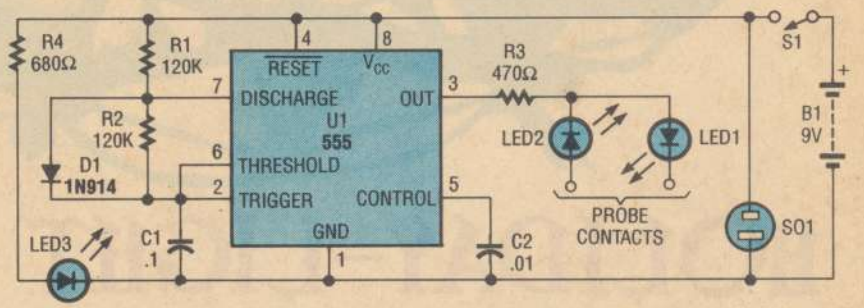


Fig. 2. The 555 oscillator/timer produces a train of pulses at its output, which are presented to LED1 and LED2 via R3.

To help explain how the circuit is used, imagine that the AC plug for a string of lights has been inserted in SO1 and one of the bulbs in the string (let's say the center-most one) has been replaced by the probe so that LED1 is touching the ground side of the bulb's socket and LED2 is touching the positive side of the socket.

With such a setup in mind, if all the bulbs in the string of lights are good, both LED's will light—LED1 will light when U1's output goes high and LED2 will light when U1's output goes low. However, if any bulb in the path between LED1 and ground is bad (open), LED1 will not light, indicating that the faulty bulb lies in that side of the circuit. On the other hand, if any bulb in the path between LED2 and the positive side of the battery is bad, LED2 will not light, indicating a problem in that part of the circuit.

Effectively, since a darkened LED indicates the troubled side of the circuit, by placing the probe in the middle of a faulty "sub-string" of lights, you immediately cut the number of suspect bulbs in half. You can repeat that process to cut the remaining number in half, again by re-installing the dislocated bulb and moving the probe to a socket mid-way between the previous location and the end of the string in the direction of the fault. By repeatedly cutting the number of suspect bulbs in half (by moving to the center of the troubled area over and over), you will eventually dislocate the bad bulb, which will cause both LED's in the probe to light.

Based on some simple math, the strategy provides quite a time savings. Take for example a string of only twenty bulbs. Instead of replacing all twenty bulbs one at a time, you need only perform (at worst) four tests and without exposure to lethal AC power! With larger strands, the tester gives you even more of an edge.

Some of you may be wondering why we chose to use a 555 oscillator/timer, instead of two separate current loops under direct power. The reason is to conserve battery life. The string of lights will quickly gobble-up battery power during normal testing. By using the 555, the battery is only connected to the good section of bulbs 50% of the time until you displace the defunct bulb. All in all, that about doubles battery life.

The reason for designing the circuit for 50% operation, as opposed to some other duty cycle, is to ensure that both LED's will have equal time to light. That is very important when the probe is placed so that there are a large number of bulbs in the path of

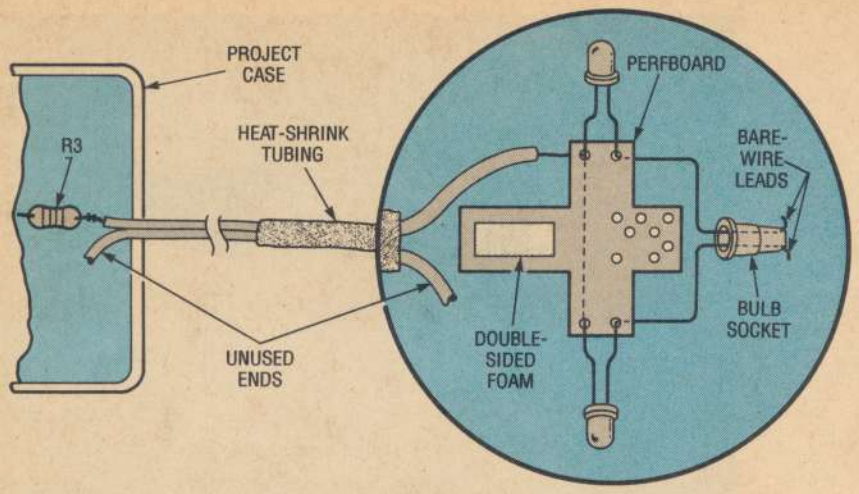


Fig. 3. The probe is made from a T-shaped piece of perfboard. One lead from each LED replaces the original bulb leads in the bulb base.

just one of the LED's: Since that LED will glow dimly due to the total resistive drop of the bulbs, it should be lit a fair amount of time to make its glow noticeable.

Helpful Tips. There are a couple of practices that will make troubleshooting even easier. First of all, most Christmas-light strings contain several separate serial circuits all connected in parallel. To ease troubleshooting, you should mark all of the bulbs in the faulty serial circuit so that you can concentrate on them alone. The best way to do that is to plug the string into an AC source and mark the base of each darkened bulb; remember, however, that you're fooling with AC (albeit it for a short time and with the protection of insulation).

Second, if neither LED in the probe lights in the course of testing, chances are you've installed the probe backwards (with LED1 connected to the positive side of the battery and LED2 connected to ground). If so, pull the probe out, flip it around, and reinstall it. If that doesn't work, there's more than one out-to-lunch bulb, and you have placed the probe between the two bad bulbs. You can find the first bad bulb by working your way toward it (half a suspect area at a time). For example, say you next test a point half-way between the completely powerless socket and the wall plug. If one of the LED's lights, you've passed one of the bad bulbs. You then back up to a socket half-way between the one you're in and the one that provided no illumination.

PARTS LIST FOR THE CHRISTMAS-LIGHT TESTER

SEMICONDUCTORS

U1—555 oscillator/timer, integrated circuit
LED1, LED2, LED3—Light-emitting diode
D1—1N914 small-signal general-purpose silicon diode

ADDITIONAL PARTS AND MATERIALS

C1—0.1-μF ceramic-disc capacitor
C2—0.01-μF ceramic-disc capacitor
R1, R2—120,000-ohm, ¼-watt, 5% resistor
R3—470-ohm, ¼-watt, 5% resistor
R4—680-ohm, ¼-watt, 5% resistor
SO1—Single AC socket
S1—SPST switch
B1—9-volt transistor-radio battery,
Perfboard material, Christmas bulb base, heat-shrink tubing, project box, wall-socket faceplate, battery clip, double-sided foam, stand-offs, wire, solder, hardware, etc.

However, if both LED's are still dark, even though the probe is inserted with the right polarity, then you haven't moved far enough (you are still between the bad bulbs). Once the first corrupt bulb is found, use the normal procedure to find the second bulb.

Getting It Together. Because there aren't very many parts required for the tester, we decided to build the circuit on a piece of perfboard using point-to-point wiring. For very complicated circuitry, it might pay to spend the time making a PC board, but for simple circuits, it's quicker to do it this way. And the light-tester circuit truly is simple—there are only seven parts mounted on the board. Wherever a point on the board must be connected to something off the board, we installed a 6-inch length of wire to be trimmed to length later on.

We mounted all of the parts, except S1, LED1–LED3, and R4 on the perfboard. The power-on indicator (LED3) was mounted on the lid of the project case, and its current-limiting resistor (R4) was wired in series with it. Switch S1, and the AC socket (SO1), were also mounted on the lid.

In order to be able to plug into a string of lights, we used the plastic base of a spare Christmas light bulb to make a "probe." Normally, a bulb is inserted into the base, and its leads protrude from two holes at the bottom. The bulb's leads are bent up around the sides of the base to hold it in place. To remove the bulb from the base, simply bend the leads out straight and pull out the bulb.

To make the probe, we used a T-shaped piece of perfboard and mounted the direction-indicators (LED1 and LED2) on it. Figure 3 shows the probe's details. One lead from each LED (the cathode of LED1 and the anode of LED2) replaces the original bulb leads. The leads are bent out of the end of the bulb base in the same way as the original bulb leads. The other two LED leads are twisted together and soldered to the wire that connects the probe to the light-tester circuit board. (Actually it's soldered to one end of R3, which is mounted on the board.)

As you can see from Fig. 3, we used two conductor wire for the probe lead, even though only one conductor is needed. The reason we did that is to secure the probe onto the wire more securely. Although shrink-wrap tubing holds the probe together, it's actually two pieces of double-sided tape or foam that secure the probe to the wire.

A simple circuit demands a simple case. There are no particular requirements, so use whatever case you have on hand. The circuit board is mounted on the bottom of the case using a couple of spacers and screws, and the 9-volt battery is held in place with a piece of double-sided tape. ■

A Hands-on Electronics REPORT

PHILIPS ECG CROSS REFERENCE SOFTWARE

CIRCLE 120 ON FREE INFORMATION CARD

A computer-based cross-reference to one of the largest stocks of replacement semiconductors.

Here at **Popular Electronics** we sometimes get letters from hobbyists building one of our many projects, but having trouble locating a source for a particular part in their area. This is to be expected, as not everyone (in fact relatively few) live in or near a major city bursting with electronics-supply stores.

Most folks in such situations resort to ordering by mail, which works out okay if your order is large enough to meet or exceed the rather high ($25 to $50) minimum-order requirement that many companies enforce. Sometimes I wait till I need enough parts to meet the minimum-order requirement, but there are times when waiting *too* long is out of the question (such as when a project is perfect for school, work, or to solve a problem at home).

There is an alternative that is readily available to just about everyone (unless you're really, really out in the sticks), and can be relatively inexpensive: the Philips' ECG line of replacement parts. The line includes a very wide range of IC's and discrete semiconductor components to make ordering replacement parts easy for field-service professionals, repair shops, and such. While the product line is typically available to professionals, you could probably find a repair shop (or repair-shop supply store) in your area willing to order ECG parts on your behalf for little or no profit (depending on how friendly they are).

Just Keystrokes Away. Ranging from the common to the exotic, it's really a shame more hobbyists don't take advantage of such an overwhelming source of parts. I suppose one reason that the ECG line gets so little attention is a lack of awareness among hobbyists. Another might be the numbering scheme of the parts—ECG parts do not have the same numbers as the parts they're meant to replace. To find the right ECG part number, you have to use a cross-reference guide. Of course, you must have the guide and the desire to look up the information.

Now there is an alternative to the paper-based guide for those with IBM-compatible computers: the ECG Instant Cross Master Guide software. Among some of its advantages over the bound edition is its low cost (possibly *free*), ease of use, and the ability to perform generalized searches for parts when you're not sure of the complete part number.

Discussing the bottom-line first, Philips is making copies of the software available to it's distributors and we hobbyists on 5-¼-inch 1.2M disks (literature No. ET-2602) for $6.50, 5-¼-inch 360K disks (literature No. ET-2603) for $9.00, and 3-½-inch 720K disks (literature No. ET-2604) for $7.50. However (and this is the nice part), they are allowing their distributors to copy and give away the software if they wish. So if you find a friendly distributor in your area that is so inclined, you might be able to get it free! Still and all, paying under $10 for anything as helpful as this software is well worth it.

To demonstrate how easy the program is to use and its general search capability, let's discuss its operation in depth. A good place to start is its installation.

Installation and Set-Up. The Instant Cross package comes with its own installation program. You just insert disk 1 in your A: drive, and type:

A:INSTALL

The installation program will then ask you some basic questions about your computer's hardware (its monitor type, its printer, etc.), asks you where you would like to load the software

(the drive, subdirectory, etc.), and then it prompts you to insert disks in the floppy drive as appropriate. Once installed typing:

ECG

on the DOS command line while you are in the sub-directory containing the ECG database is all you need to do to start the program.

The first thing you are greeted with is a video-based duplicate of the ECG manual's front cover and after a second or two, it is replaced by a software copyright notice, which vanishes to be replaced by a legal notice. Press enter to move past that screen to one that is provided for distributors to display a message that'll remind customers where they got the nifty software package (thumbs-up to the guys in marketing).

By pressing enter again you arrive at the main menu. It has a highlight bar that can be moved up and down (via the up and down arrow keys) to point to an option on the menu. As true of all the screens in the program, pressing escape allows you to exit, and the bottom line of the screen tells you what other keys are applicable to the screen. In the case of the main screen, only the escape, up and down arrow, and enter keys are applicable.

The main menu has three options to select from: "Find ECG Replacement Part Number," "Utility Menu," and "Exit to DOS." Of course, the first option allows you to find the ECG part number to replace a part, the second option allows you to set up the software's appearance and execution to your liking, and the third option lets you exit the program.

Let's look at how you can configure the software first. The menu for software configuration allows you to tailor several of the program's characteristics. To alter any of them, you need only to point to it with the highlight bar using the up and down arrow keys and press enter. Each time you press enter, the configuration of the item selected will change. For example selecting the "Select Monitor Type" option and pressing enter will toggle the program between monochrome and color operation.

If you select color operation, you may use some of the other options on the menu to alter the color of the text, the background, the highlight bar, and text in the highlight bar. First move the highlight bar over the option that lists what you'd like to change. Then press enter to change the color of that item. Each time you press enter, the item will change to a different color. If you don't like any of the colors you've chosen, you can force everything to black and white with the "Select Black and White" option.

There is a "Minimize Startup Time" option that, when activated, will make starting the program quicker next time you run it. It does that by reducing the amount of time the opening screens appear.

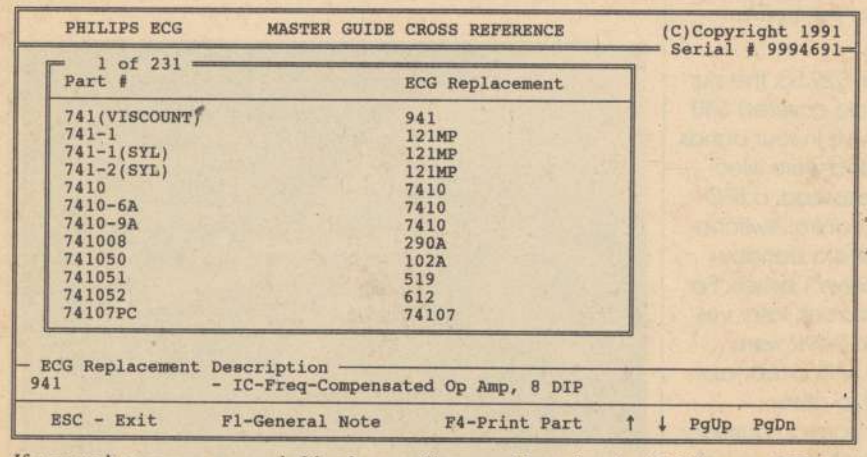
Unless you utilize the "Make Changes Permanent" option, all the parameters you have set-up will only be applicable during the current software session; when you exit, the changes will be lost. Using that option will ensure that every session after this one will run as you have set it up this time around.

The last option, "Main Menu," allows you to leave the utility menu and return to the main menu. Of course that could also be accomplished by pressing the escape key. With everything all set, you're ready to hunt for parts.

Searching. If you select the "Find ECG Replacement Part Number" option from the main menu, you are presented with a screen that allows you to enter the number of the part you want an ECG number for. For example, you could enter "741" to find Philips' version of the 741 op-amp. However, the program will provide you with a list of 231 parts, not all of them op-amps. That is not a flaw in the program; it occurs to help you just in case you only knew the first few numbers of a part number. This generalized searching can be a real help for times when you are unsure of a full part number or manufacturer. If your information is too general—generating a list of over 255 parts—the program will ask you to be more specific. If you enter "LM741" (the designation for National Semiconductor's version of the 741), it will narrow the possibilities down to just a few parts; all of them different versions of the 741 op-amp made by National.

You can find the correct part from a list of parts by moving the highlight bar over each member of the list. That causes some of their specifications to appear near the bottom of the screen. If there are special considerations to be aware of for using the ECG part as a replacement, notes will appear along with the specifications. The notes are a little cryptic, but if you aren't sure of what they mean you can call up a glossary of notes by pressing the F3 key. If you want a print out of the specifications, you just press the F4 key.

Using the program is just that easy. Basically that means you may be able to find the semiconductors you need quickly, easily, and locally. For more information on the Philips ECG Instant Cross Software, you can contact Philips ECG (Customer-Service Department, 1025 Westminster Dr., Williamsport, PA 17701) directly or circle No. 120 on the Free Information Card. ■



If a search was very general, like the one illustrated here for the "741", up to 255 parts can be presented for you to scan. Had you entered "LM741" instead of just "741", the program would've presented you with fewer choices.

ANTIQUE RADIO

By Marc Ellis

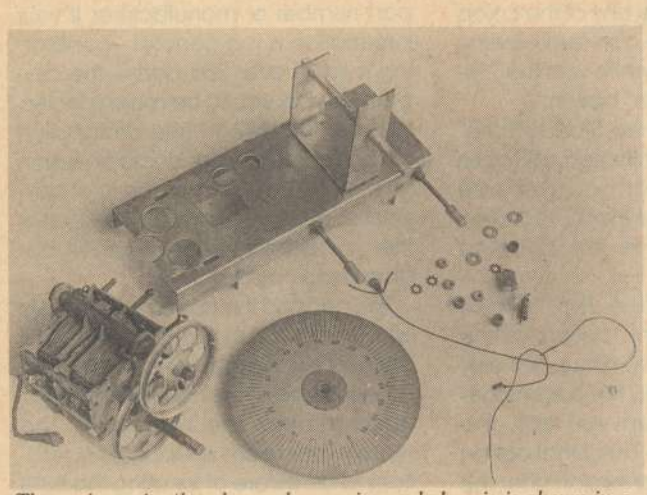
Reassembling the Sky Buddy

After playing hooky last month, this column finds me at the workbench again, picking up where I left off on our Sky Buddy restoration project. Or, to put it more accurately, *backtracking* on the restoration project. But more on that in a minute. First, for readers who may have just joined us, a brief synopsis of what's happened so far.

The *Hallicrafters Sky Buddy Model S-19R*, introduced in 1939, was a popular starter set for hams and shortwave listeners in the years just prior to World War II. Selling at $29.50, the sturdy little radio covered 540 kHz to 50 MHz in four bands. Also included were electrical bandspread, a BFO with pitch control, switchable AVC, and a standby ("send-receive") switch. For the adventurous, later versions of the S-19R were equipped with a rear-apron socket to allow operation from an auxiliary power source such as batteries, vibropack, etc.

We first started talking about the Sky Buddy in the May, 1992 column, which was devoted to historical information on the radio. In June, we took a first look inside the set, performed some basic physical and electrical checks, and found a few signs of life upon carefully applying power. The next columns devoted to the Sky Buddy were those of September and October, in which we partially disassembled the radio for cleaning and restoration, and also spent some time discussing the circuitry.

Last month, I played hooky and didn't accomplish any restoration work worth reporting. But this month the Sky Buddy saga continues.



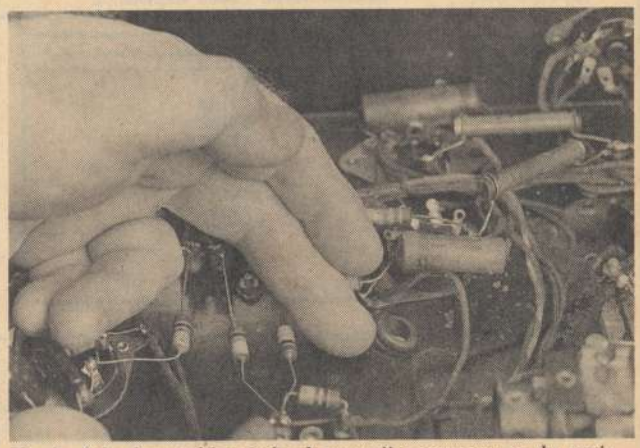
The main tuning/bandspread capacitor subchassis is shown in a disassembled condition, but clean and ready to put together.

RETHINKING THE SUBCHASSIS

Picking up the project where I had left off in the October issue, I realized that I was dissatisfied with my work on the subchassis holding the main tuning/bandspread capacitor. I had gone to quite a bit of trouble to remove this unit in order to facilitate cleaning the main chassis, restringing the dial cords, and replacing the hardened and brittle "shock-mount" grommets on which the subchassis was mounted.

Although I had performed all of those operations, I'd hurried a bit too much toward the end and left the subchassis and tuning capacitor a bit too dirty for my taste. That was partly because of the many nooks and crannies in those units, and party because of the ambiguous nature of the splotchy dark substance coating the subchassis. Was it a tenacious dark grime that should be removed with steel wool and elbow grease? Or was it a deteriorating paint surface that should be treated gently so as to preserve its original appearance as much as possible?

I still wasn't sure, but I felt that the subchassis was a little too unpresentable to reinstall. In an earlier restoration performed on these pages (involving an Echophone EC-1), I had



Each of the four rubber "shock mount" grommets on the main chassis was replaced prior to reinstalling the subchassis.

successfully cleaned a really filthy tuning/bandspread capacitor with a gasoline bath followed by a blow-off with compressed air. So I decided to repeat the tactic on the Sky Buddy's capacitor and subchassis.

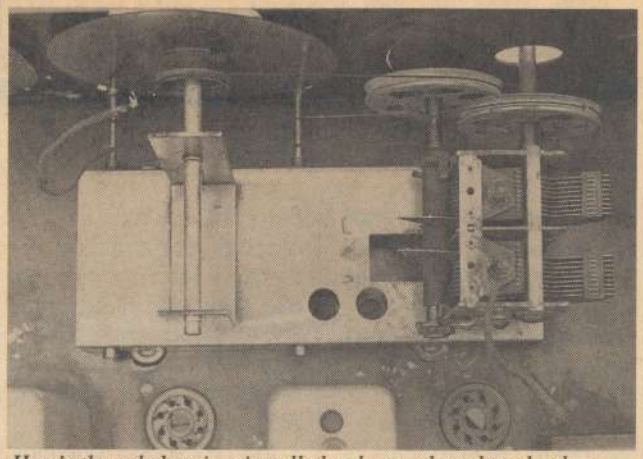
The equipment emerged from this treatment several degrees cleaner, though I still wasn't sure about the nature of the dark coating on the subchassis. However, whatever the gasoline bath hadn't taken off could now easily be removed by scraping with a fingernail, exposing what looked like a cadmium-plated surface underneath. Throwing caution to the winds, I decided to remove it altogether.

Removing the tuning/bandspread capacitor from the subchassis (and in the process ruining my dial-cord stringing job), I attacked the surface with fine steel wool soaked in detergent. In short order, I had all of the dark material cleaned off, exposing the underlying bare metal. The result was much better looking, though I still don't know if I removed an original coat of paint. Maybe a reader can advise me.

THE REINSTALLATION PROBLEM

Remounting and restringing the capacitor, I found that the operation of both the main tuning and bandspread controls was rough and noisy. Since the gasoline bath would have removed any lubrication that may have been present, I placed one drop of S.A.E. 30 motor oil on each of the tuning-capacitor pivots and at each end of the two drive shafts mounted on the subchassis. Operation became smooth and quiet once more.

Now I was ready to reinstall the subchassis. As

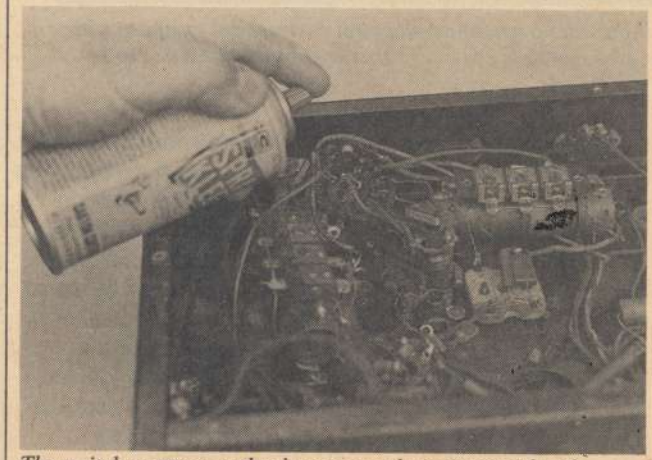


Here's the subchassis reinstalled at last and ready to hook up.

mentioned, that unit "floats" on four rubber grommets installed on the main chassis. Each grommet is sandwiched between a pair of dished washers, one inserted into the grommet from above the chassis and one inserted from below. Four threaded spade lugs, each perhaps half an inch long, extend downward from the subchassis—one near each corner. These pass through the holes in the dished washers, and are held in place by washers and nuts installed under the chassis.

The subchassis had been very difficult to remove in the first place, and proved to be even tougher to install. In a nutshell, the nature of the problem was this: Protruding from the front of the subchassis are two control shafts intended to pass through matching holes in the front panel. When the subchassis rests on the main chassis supported on its spade lugs, the control shafts are too high to pass through the holes; in order for the shafts to be low enough, the spade lugs have to be inserted down through the holes in the dished washers.

But, as the subchassis rests on the chassis, the spade lugs are too far back to pass through the holes in the washers. To place them in the proper position, the subchassis has to be slid forward—which is only possible if the control shafts can be moved forward through their front-panel openings.



The switch contacts and volume control were sprayed with contact cleaner prior to concluding this month's work session.

This seemingly insoluble problem was resolved by tipping up the back edge of the subchassis, allowing the control shafts to slant downward through their panel holes. The subchassis was then inched forward, with the front set of spade lugs dragging against the main chassis. There was just enough clearance to inch those lugs over the tops of their rubber grommets so that they could drop through the holes in the washers. Once the front lugs were seated, the back ones were easy to drop in and the unit was ready to bolt down.

The first time I attempted this procedure, I knocked both front washers out of their seats in the grommets. I also noticed that the celluloid bandspread-calibration disc (mounted near the front of the subchassis) was being bent against the inside wall of the front panel and was in danger of cracking. Loosening the disc's setscrew and temporarily sliding it farther back on its shaft solved the latter problem; practice in manipulating the subchassis solved the former one. Finally, at long last, the assembly was seated properly and fastened down.

SOLDERING STRATEGIES

Once the subchassis was mounted, the connections to the tuning capacitor could be restored. Readers who have been following this restoration from the beginning will recall the difficulty I had desoldering that capacitor's heavy ground braid when the unit was being removed. Because of the heat-sinking effects of the heavy braid and the main chassis (to which the ground lug was

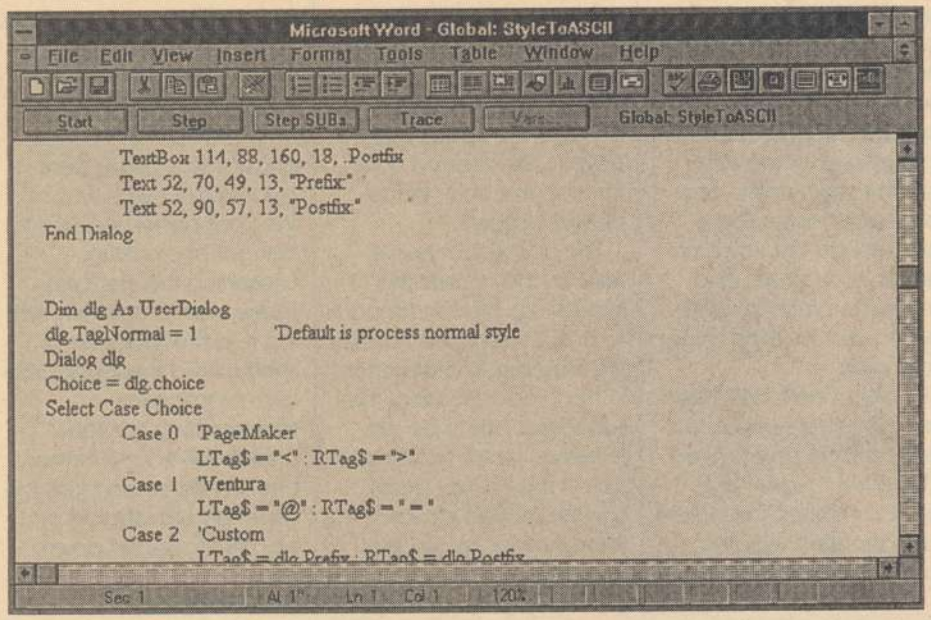
(Continued on page 92)

COMPUTER BITS

By Jeff Holtzman

WordBASIC II

For the past few months, we've been discussing the emerging third wave in software, integrated tool sets, using Microsoft's Word for Windows 2.0 (WW2) as an example. Last time, I presented some simple WordBASIC (WB) macros intended to give you a taste for the power and flexibility of the language. This time, I'd like to continue the discussion by comparing WB with the macro language in WordPerfect 5.1.


Microsoft Word - Global: StyleToASCII
File Edit View Insert Format Tools Table Window Help
Start Step Step SUBs Trace Vars Global: StyleToASCII
TextBox 111, 88, 160, 18, .Postfix
Text 52, 70, 49, 13, "Prefix:"
Text 52, 90, 57, 13, "Postfix:"
End Dialog
Dim dlg As UserDialog
dlg.TagNormal = 1 'Default is process normal style
Dialog dlg
Choice = dlg.choice
Select Case Choice
Case 0 'PageMaker
LTag$ = "<" : RTag$ = ">"
Case 1 'Ventura
LTag$ = "@" : RTag$ = " = "
Case 2 'Custom
Sec 1 At 1" Ln 1 Col 1 120%

Microsoft's Word For Windows 2.0 provides a macro-development environment complete with single-stepping and trace features, plus the ability to alter variable values while a macro is running.

What is WB? It's like a mid-1980's version of BASIC on steroids. The mid-80's part involves a reasonably strong version of BASIC; the steroids part involves additional functions specific to text processing.

Plain BASIC functions give you program control (call, for/next, if/else, while/wend, select case, etc.), screen and keyboard control (input, print, inputbox, msgbox, etc.), string and numeric functions (asc, chr, instr, left, mid, right, abs, int, sgn, rnd, val, etc.), sequential file handling (open, close, read, write, input, line input, etc.), and more.

Text processing functions allow you to open and close document files, define and go to specific points in a document, obtain information about and alter the WW2 environment (including menus and keystroke commands), control DDE conversations between WW2 and other applications (more on this below), create windows dialog boxes (with check boxes, radio buttons, list boxes, etc.), perform search and replace operations (on text, formatting, and styles), apply formatting under program control, and quite a bit more.

DEVELOPING MACROS

Developing WB macros is a pleasure, thanks to the clean way Microsoft has implemented the system. You can record a macro and subsequently edit it, or simply edit it from scratch. The macro editor works just like a regular text editing window, and allows you to search and replace, copy, and move just as with normal document text. WordPerfect, by contrast, gives you a special macro editing window that does not work like the regular text editor, and that doesn't allow search/replace, copy, or move. With WW2, you can have one or several macro windows open simultaneously, along with one or several document windows (for a maximum of nine). WP, by contrast, does not allow simultaneous macro and document windows.

WW2 gives you better macro management tools than WP. You store one or more macros in document templates; every macro in a template will be available to all documents based on that template, and any macros in a special template called NORMAL.DOT will be available to all documents. Each macro can have a long name (about 30 characters) and a separate description. Convenient dialog boxes allow you to select a macro to edit, run, put on a menu, and associate with a keystroke or toolbar button. By contrast, WP stores every macro in a separate file; names are consequently limited to eight characters, and you

must remember what they mean. Word's macro language is much richer than WordPerfect's.

WW2 also gives you better macro development tools than WP. For example, you can single-step your way through a macro, watching as WW2 highlights each line in turn. WP has a single-step mode that forces you to view streams of characters (*e.g.*, each letter in a text string or variable name), and press a key after each is interpreted. Each keyword is displayed as a numeric code, so you have to keep a cross-reference chart handy. WW2 allows you to alter variable values during execution; WP does not.

Ironically, WP provides a better development environment than many full-scale programming systems of just a few years back. It's not hard to imagine using WW2 and WB for an introductory course on computers and programming.

But we have spent enough time on macros. Now let's get back to talking about using WW2.

LINKING FILES

In the not-so-good old days (about ten years ago), most people created school and business reports by typing them. Using a word processor was more efficient than using a typewriter, but not by much. Conceptually, the process of creating a document was the same either way. Type your text, leaving big chunks of space for illustrations and charts. After the text is finalized, paste in the graphics. If they don't fit, either retype the text or live with the final results.

Nowadays there are better ways. Modern word processors provide the ability to assemble documents by linking separate chunks of text, graphics, and charts all created in different applications, by different users, at different times. Each time a revision of the document must be published, just update the links to the other files and print. In the meantime, different people can continue working on different segments.

Assembling documents like that is not difficult with WW2. For example, you can select a range from an Excel spreadsheet, switch to Word, and then perform an Edit Paste Special operation, making sure to press the Paste Link button. Or suppose you have a graphics file created in Paintbrush or some other graphics editor. Just choose Insert Picture and select the desired file through the dialog box. Note the checkbox labeled "Link to File." Make sure that it's checked, otherwise updates to the image won't appear in the document. WW2 supports files in PCX and TIF bitmap formats, and several vector formats (*e.g.*, AutoCAD, Designer, EPS) as well.

When it's time to publish a draft and you want to get updated versions off all linked files (spreadsheets, graphics, even other text files), select the entire document CTRL-5 and update the links F9.

You can even set up automatically updating links by using Dynamic Data Exchange (DDE). For example, one company I work with closely has designed a system that collects data from manufacturing machinery and routes it to real-time data displays built from Excel spreadsheets and WW2 documents. Performance is somewhat slow, but it works, and as computer hardware prices continue to plummet, the performance issue will evaporate. ■

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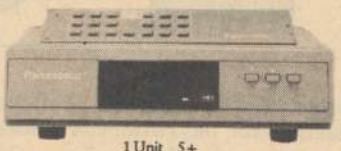

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CIRCLE 14 ON FREE INFORMATION CARD

CIRCUIT CIRCUS

By Charles D. Rakes

MC14538 Monostable Applications

This month, I'd like to share several simple, but useful, circuits that can stand alone or be used as part of a more complex circuit. In any case, it's my hope that you'll find at least one of these circuits useful for an upcoming project.

EXTENDED ON-TIME TIMER

Figure 1 shows a circuit wherein half of a Motorola MC14538B dual, precision, retriggerable monostable multivibrator is used to form an extended on-time timer circuit. That type of circuit can be used as what is commonly known as a switch debouncer. Such circuits are often used in digital circuitry, where each and every bounce of a switch contact is seen as a separate digital input.

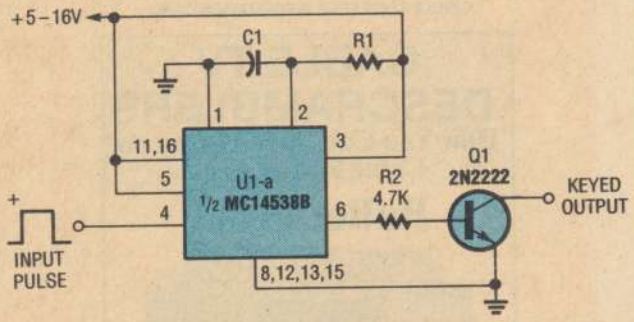

Fig. 1. Built around half of a MC14538 dual, precision monostable multivibrator, this circuit can be used as what is commonly known as a switch debouncer.

The circuit's extra-long on time allows the contact bounce of mechanical switches to stabilize. Because the output remains at a constant level, the connected circuitry sees only one input pulse. The circuit may also be useful in providing a timed "on" input to a circuit that requires a minimum start-up time.

PARTS LIST FOR THE EXTENDED ON TIME TIMER

U1—MC14538B dual, precision monostable multivibrator, integrated circuit
Q1—2N2222 general-purpose NPN silicon transistor
R1—10,000-ohm to 10-megohm, ¼-watt, 5% resistor (see text)
R2—4700-ohm, ¼-watt, 5% resistor
C1—0.1 to 10-μF, 25-WVDC, electrolytic capacitor (see text)
Perfboard materials, enclosure, 5–16-volt power source, IC socket, wire, solder, hardware, etc.

The delay on time (established by C1 and R1) is easily set using the formula:

$$C1 \times R1 = T$$

where C1 is in microfarads, R1 is in megohms, and T is in seconds. A practical example would be to use a 1-μF capacitor and a 1-megohm resistor as the timing components. By placing those two values in the formula, we get 1 μF × 1 megohm = 1 second.

The operation of that circuit is rather straightforward. In the quiescent state (with no input), the output of U1 at pin 6 is low, holding Q1 at cutoff. Now, if a positive-going pulse is applied to the input of U1 at pin 4, the output of U1 at pin 6 goes high and remains so until the time period established by C1 × R1 has expired.

If another positive-going pulse is applied to the circuit before the on time has elapsed, the on time period is increased by an amount equal to the initial on time set by C1 × R1 (using the above example, that's 2 seconds total). That feature allows the circuit to be used as a keep-alive circuit to maintain the operation of a device or sub-circuit that shuts down when the input is removed. The output of the circuit will remain high as long as a positive trigger is reapplied to the circuit before time-out occurs.

NO-DOZE ALARM

Our next entry—based, once again, on the Motorola MC14538B dual, precision, retriggerable monostable multivibrator—is a keep awake or no doze circuit that might just help keep you from harms way. If you have trouble staying awake while working, reading, etc., the no-doze circuit shown in Fig. 2 may be just the ticket. That circuit sends out a loud tone if the input switch (S2) is not retriggered at preset intervals. If you fall asleep and miss retriggering the circuit, it will sound off until you wake up and press S2.

Although the circuit can help keep you from going to sleep, it would be wise to never ever rely on this or any other gadget for that purpose. The circuit's operation is similar to that of the previous circuit, but with a reversal in the output status. Instead of keeping the output high by repeated triggering, this circuit's output remains low as long as the circuit is continually retriggered within the preset time period.

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With S3 in position A (as shown), C1 and R1 set the time interval to about 50 seconds; with S3 in position B, the time interval is reduced to around 15 to 20 seconds. To select a different time period, use the formula outlined for the previous circuit.

Applying power to the circuit sets U1's output at pin 7 high, supplying drive current to Q1, which causes BZ1 to sound. As soon as S2 is pressed, BZ1 turns off and remains silent until the set time period elapses. If S2 is pressed at any time before the time period runs out, an additional 50 seconds (S3 in position A) will pass before BZ1 sounds.

Since U1 triggers on the rising edge of the input pulse, merely holding S2 closed will not keep the circuit from sounding. Switch S2 must be released and reactivated for the circuit to register the new trigger pulse. Buzzer BZ1 must be a self-oscillating piezo-type sounder; one that has a pulsed output would be the best choice. It's very difficult to go to sleep when an interrupted tone is present.

The previous two circuits were triggered on the leading edge of a positive-going pulse. However, Fig. 3 shows how to modify the inputs to those circuits so that they can be triggered on the falling (negative-going) edge of the input pulse.

SELF-RETRIGGERING TIMED-ON GENERATOR

A self repeating feature can be added to the basic monostable multivibrator by reconfiguring the circuit as shown in Fig. 4. In that circuit, an NPN transistor and a few other components are used to turn the manually driven circuit into a repeating timed-on generator. The values of C1 and R1 determine the time that U1's two outputs, at pins 6 and 7, are high and low, respectively. The output at pin 6 is positive going, while the one at pin 7 is negative going.

The operation of this circuit, like the previous circuits, is rather straightforward. When power is first applied to the circuit, C2 begins to charge via LED1, R3, and R4. When the voltage across C2 reaches U1's input trigger level, the output of U1 at pin 6 goes positive for a period determined by the values of C1 and R1. That turns Q1 on, discharging C2 through D1 and Q1.

At the end of the set period, the output of U1 at pin 6 goes low, turning Q1 off and allowing the current to begin flowing through LED1, R3, and R4 to again charge C2, causing the cycle to repeat. The repeat time is determined by the values of R3, R4, and C2. The previous formula won't be as accurate for this circuit, but it will at least get you close enough for the capacitor value; then R4 can be fine-tuned to obtain the desired timing period.

LAMP-SWITCHING CIRCUIT

Our final circuit (see Fig. 5) places the MC14538B in a timed lamp-switching circuit that may be connected in parallel with

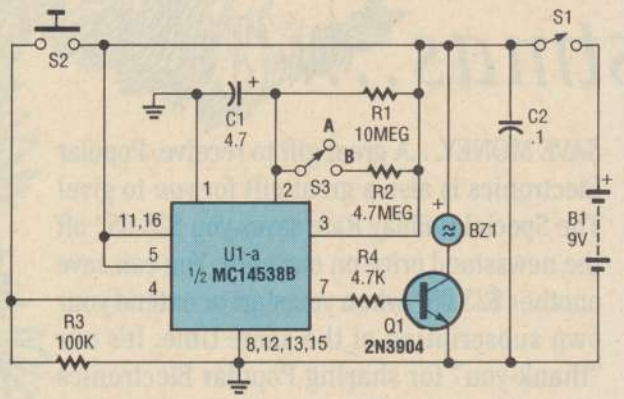

Fig. 2. The No-Doze Alarm may be just the ticket for those who have trouble staying awake while working or reading.

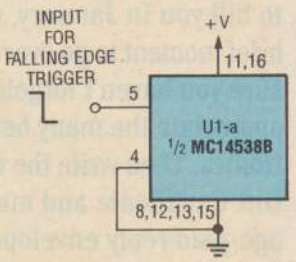

Fig. 3. By reconfiguring the inputs to the previous circuits as shown here, each can be made to trigger on the falling (negative-going) edge of the input pulse.

PARTS LIST FOR THE NO-DOZE ALARM

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1—10-megohm
R2—4.7-megohm
R3—100,000-ohm
R4—4700-ohm

ADDITIONAL PARTS AND MATERIALS

U1—MC14538B dual, precision monostable multivibrator, integrated circuit
Q1—2N3904 general-purpose NPN silicon transistor
C1—4.7-µF, 16-WVDC, electrolytic capacitor
C2—0.1-µF, ceramic-disc capacitor
BZ1—Piezo buzzer (see text)
S1—SPST switch
S2—Normally open, pushbutton switch
S3—SPDT switch
B1—9-volt transistor-radio battery
Perfboard materials, enclosure, IC socket, battery holder and connector, wire, solder, hardware, etc.

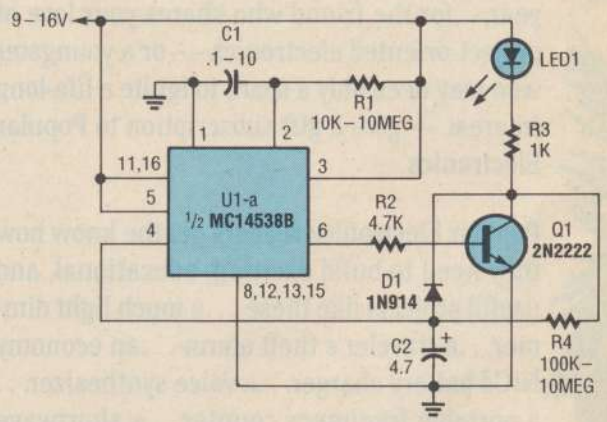

Fig. 4. A self-repeating feature can be added to the basic monostable multivibrator by reconfiguring the circuit as shown here.

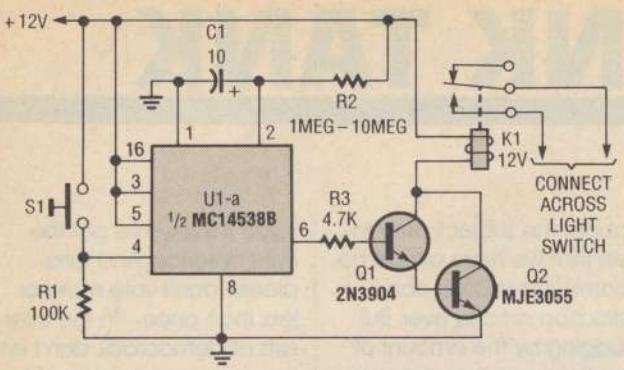

Fig. 5. The Lamp-Switching Circuit can be connected in parallel with the on/off switch of most lamps to provide a delay turn-off function, thereby allowing you to exit a room or area while the lights are still on.

PARTS LIST FOR THE SELF-RETRIGGERING TIMED-ON GENERATOR

SEMICONDUCTORS

U1—MC14538B dual, precision monostable multivibrator, integrated circuit
Q1—2N2222 general-purpose NPN silicon transistor
D1—1N914 general-purpose, small-signal silicon diode
LED1—Light-emitting diode (any color)

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1—10,000-ohm to 10-megohm
R2—4700-ohm
R3—1000-ohm
R4—100,000-ohm to 10-megohm

ADDITIONAL PARTS AND MATERIALS

C1—0.1- to 10-µF, ceramic-disc capacitor
C2—4.7-µF, 16-WVDC, electrolytic capacitor
Perfboard materials, 9–16-volt power source, IC socket, wire, solder, hardware, etc.

PARTS LIST FOR THE LAMP-SWITCHING CIRCUIT

SEMICONDUCTORS

U1—MC14538B dual, precision monostable multivibrator, integrated circuit
Q1—2N3904 general-purpose NPN silicon transistor
Q2—MJE3055 NPN silicon power transistor

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—100,000-ohm
R2—1- to 10-megohm
R3—4700-ohm

ADDITIONAL PARTS AND MATERIALS

C1—10-µF, 25-WVDC, electrolytic capacitor
S1—Normally open, pushbutton switch
K1—12-volt relay (see text)
Perfboard materials, enclosure, 5–6-volt power source, IC socket, wire, solder, hardware, etc.

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the on/off switch of most lamps so that you can leave a room or area and have light to see by as you exit. Since the output is relay controlled, the circuit will operate with either AC or DC light circuits. The maximum lamp wattage that the circuit can handle is limited only by the relay's specifications. An ideal application for that circuit would be to delay the shutdown off your auto's headlights.

The operation of the timed lamp-switching circuit is very similar to the circuit in Fig. 1. A normally open pushbutton switch (S1) delivers a positive input pulse to pin 4 of U1, triggering the IC into action. The output of U1 at pin 6 supplies base-drive current to a Darlington pair comprised of Q1 and Q2, activating K1. A 10-µF capacitor and any resistor value of from 1 to 10 megohms may be used as the timing components. Use the same simple timing formula as previously described (see Extended On-Time Timer) in selecting the values of R2/C1 for your circuit.

To use the circuit on your auto's headlights, just connect the relay's normally open contacts across the car's headlight switch and press S1 to extend the on time. In connecting the circuit to control an AC-operated lamp, turn off the AC power and connect the relay contacts in parallel with the lamps power-switch contacts.

Well, that looks like a wrap for this month. But, we invite you to check-in again next month when we will present more circuits to entertain and educate you in the ways of electronics. Until then, may the flow be with you. ■

THINK TANK

By John J. Yacono

Do You Compute?

Over the years, a great (but friendly) controversy has been raging here at the magazine. Oddly enough, the contention has been caused by our readers, but it's left up to us here to "duke-it-out." It revolves around the amount of computer coverage we should provide.

Some readers remember how the old **Popular Electronics** (produced by another company who shall remain nameless for the sake of pretense) went way-way overboard with computer coverage—they even changed the name to reflect their then-new slant. Of course, many of those readers (and I was one) felt let-down, and very strongly caution us not to make the same mistake, lest we meet with the same fate.

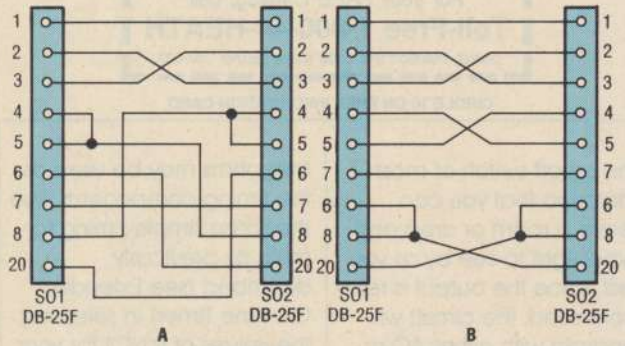

Fig. 1. In past issues, we've shown more than one possible null-modem cable. The ones shown here are from the August 1990 (A) and January 1991 (B) editions.

Many of those readers don't own a computer and have no use for such information. Although I like computers, I respect and understand their feelings: Why buy any magazine that refuses to cater to you? There are even some in that camp that feel so adamant about the subject as to insist that we have almost no computer-related construction articles ever. But judging by the amount of mail we get, they seem to be a fringe group.

Diametrically opposed to that faction are readers that like computer-related topics. We have received requests for at least a little more computer coverage, and whenever I've written stories regarding computers, I've gotten positive mail on them—perhaps because the negative mail got sent to the Editor, but I think that's unlikely. In fact, from where I sit, it looks as though computer articles get more and nicer mail than some articles on other topics. However, that could simply mean that computer enthusiasts have become more "vocal" than in past years.

Of course, it's our job here at the magazine to sort out those opinions to provide coverage with the broadest appeal. We will not abandon anyone for the sake of any one issue (regardless of its indirect affect on all of us). As an editor, columnist, and author, I have to take that responsibility very, very seriously in order to make the readership happy, so I'm calling on the readers of this column to help me and the magazine nail-down the issue. Just send a postcard or letter to me here at *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. It doesn't have to be wordy, just write "more" if you want more computer coverage, "less" if you think we have too much, or "fine" if you think we've got the right balance. And folks, please don't vote more or less than once—in the interests of democracy, don't let the more vocal group decide.

To be honest though, the vote won't change this column much at all. I'll still present a broad range of circuits and topics, answer general questions, and provide helpful tips. I just want to get a feel for how many of my readers like computer stories, so that I can be sure that I won't upset too many of you if I devote maybe one column a year to computer-related stuff. If you feel like including more information with your card or letter, please let me know if you've ever built a computer-based project and if so provide some details.

Which brings me to the topic for this month's introduction: some helpful, but little-known, computer tricks. This topic was inspired by a couple of computer-related letters I've received lately, which I'll get to in a little bit.

TWO-MINUTE HACKS

As you deal with computers, like anything else, you pick up a few unusual tricks along the way. Some of the tricks work because there are some undocumented features in either the hardware or software. Many of those tricks make life (the computing portion of it anyway) a little easier. For example, wouldn't it be nice if DOS wouldn't pester you with the "Not ready reading drive A:, Abort, Retry, Fail?" query just

because you've accidentally inserted an unformatted disk or forgot to close the drive door? You can eliminate that hassle by using an undocumented DOS switch. If you look in your CONFIG.SYS file, you may find a command of the form:

SHELL = *commandfile*

where *commandfile* is the path and filename used to locate the COMMAND.COM file on your computer. My COMMAND.COM file is in the DOS sub-directory on my C drive, so the line in my CONFIG.SYS file looks like:

SHELL = C:\DOS\COMMAND.COM

If your CONFIG.SYS file doesn't have that command in it, add it but replace *commandfile* with the path and filename for your COMMAND.COM file. Now by adding "/F" to the end of the line like this:

SHELL = *commandfile* /F

you'll be telling DOS to automatically answer the "Abort, Retry, Fail?" question with "fail" any time it pops up. Once the change has been made to the CONFIG.SYS file, you'll have to reboot your computer for the change to take effect. I'm not sure which versions of DOS this won't work on so test it out by requesting a directory of an empty drive. The "Abort, Retry, Fail?" message will appear but it will just scroll by placing you back at the command line. That trick really makes DOS less annoying.

Windows also has a couple of undocumented features that make life easier. For example, next time you want to run Windows, use the command:

WIN :

The colon switch suppresses the logo screen. It was probably used by the software writers to save time during beta tests.

A program called SYSEDIT is another undocumented, but much more useful feature of Windows. It allows you to view and edit your AUTOEXEC.BAT, CONFIG.SYS, and Window's INI files all at once. Just select run from the file menu under the Program Manager and enter SYSEDIT. The files will appear in four cascaded windows. I like to tile the windows so that I can see them all at once. It's really a time saver for optimizing your resources, such as to help you load programs and drivers into high memory.

Another trick I picked-up by trying something that seemed stupid (or at least nonsensical). I needed to set-up my system to access the memory between 640k and 1MB as it had been done improperly by my computer vendor. After great difficulty, I was able to convince their technical support staff that this was the case, and they provided me with the instructions to set things right. It involved going into my system's extended CMOS setup (a real no-no unless you really know what you're doing) and setting some critical bits there. I followed the instructions to the letter and allowed the system to reboot once I was done. To my dismay, the changes didn't take. I didn't want to hassle with tech support again, so in a fit of desperation (creativity?), I decided to do something seemingly silly. I went into the extended CMOS setup to check to make sure everything was as I set it, then I went into the regular CMOS setup, left that, and rebooted. This time the changes took—go figure. I

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have since learned that this problem is due to the NEAT chipset installed on some computers. The moral is "When all else fails, try the absurd."

The last couple of items I have to offer fall more into the category of tips rather than tricks. The first is not to be too *gung-ho* about formatting a box of new disks; some may already be formatted! If you check each disk in the box, you may find a couple that have been formatted at the factory as part of their quality-control procedure. (The checking procedure will be greatly facilitated by the /F trick given earlier.)

The second tip is hardware oriented. If you find that your mouse cable is not long enough to suit your setup and it has a 9-pin connector, try using a joystick extension cable. Select one intended for use with the Adam computer, Atari 2600 video-game system, Atari 400/800 computer, Colecovision, Comodore VIC-20 or 64 computers, Sears Video Arcade, or NEC PC-6001 computer. However, don't use anything intended for PC compatibles as they have 15-pin connectors.

Now for our letters.

NULL FOR A VOID

I would like to build a null-modem cable so that my laptop can communicate with my desktop via the serial port. However, there is some confusion as to the proper wiring for it. Two articles in past issues of **Popular Electronics**, which appeared in August 1990 and January 1991 have shown different wiring schemes (As shown in Fig. 1). A third wiring scheme (see Fig. 2) is shown in a popular computer hardware catalog. Which is the most correct?

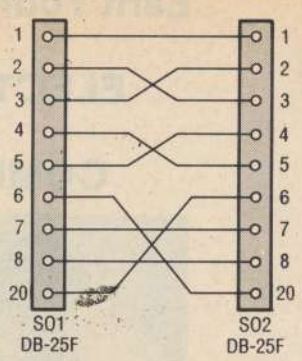

Fig. 2. A very popular electronics catalog featured this null-modem cable. It might work, but having pin 8 on both computers tied together seems a little suspicious as they are both inputs—where are they receiving input from?

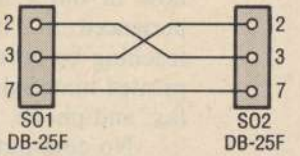

Fig. 3. Preferring a simple approach, I have often used this three-wire cable to make null-modem connections. It places the burden of handshaking on the software.

Also, I noticed that not all pins are used. While in some cases that is understandable, as you wouldn't want power supplies bucking each other, are there other pins that should be connected to make a more complete connection?

—Thanks Paul Cabibi, West Valley City, UT

If you continue to look, you are really likely to find a dozen or so different ways to prepare a null-modem cable. That's due to the lack of true standardization in serial communications. Some of those cables may work, while others will not.

To throw my own two cents in, one of the cables that has always worked for me is a simple three-wire cable. Judging from the wiring information you've provided, I can assume that both your machines have 25-pin connectors. A simple three-wire cable for such a setup would be 2-3, 3-2, 7-7, as shown in Fig 3. To use this cable successfully, set your communications software up for a null-modem connection with the XON/XOFF protocol enabled. What that does is place the burden of handshaking on the software so that the hardware (the cable) doesn't matter.

If your software doesn't support the cable (which would be a little odd), you really need the help of a good troubleshooting book. I strongly recommend Computer Connection Mysteries Solved, *by Grahm Wideman, published by Howard W. Sams & Co. That book has helped me so much that I wish I knew the author personally so that I could thank him. As you'll find out from the book, RS-232 serial ports are resilient enough to withstand improper wiring, so feel free to experiment.*

Addressing your concern about the number of pins used, only 10 are really used by PC's: 1, 2, 3, 4, 5, 6, 7, 8, 20, and 22. Pin 1 is a case ground, which needn't be used, and pin 7 is the signal ground. Pins 2 and 3 are the transmit and receive pins, respectively, so they should be simply cross-connected (2 to 3 and 3 to 2) between the two machines. That leaves you with only 6 pins (4, 5, 6, 8, 20, and 22) to worry about.

To further reduce the possibilities, only pins 4 and 20 of that group are outputs. Since each of the four inputs should be connected to only one of the two outputs, each device has only 16 (which is 24) possible connections. Since the connections for the laptop and the computer can be figured out separately (if it receives the right handshaking signals, the computer can transmit regardless of whether or not the laptop can, and vice versa) that leaves you with 32 (or 16 × 2) possible connections for the whole cable. Between that information and the book, you should be able to figure out a cable that works, even if by trial and error.

SYS WITHOUT SIZZLE

I do have a problem that has been running me ragged for about a month, and the answer to it is probably very simple. I have a Packard Bell (PB VX588) computer; it has a VIC 40 microprocessor, a 5.25-inch, 360k floppy drive, and a Seagate 20MB hard drive. I recently obtained a PSPICE program for school that is on two 5.25-inch, 1.2MB floppies (which I didn't know until I received them). I thought I could remedy my problem of being able to read the floppies by buying a 1.2MB floppy drive and multiple-floppy controller. But to my dismay, I couldn't get my computer to read the new drive. I found out that I had to have at least DOS 3.3 to read the drive.

When I got the hard drive for my computer, I formatted it with MS-DOS 3.2 because I liked the way the 3.2 worked better than I did the 3.3 version that I have. My problem is that I don't understand how to set up my CONFIG.SYS file to address the 1.2MB drive. My file at this time is as such:

Files = 15
Buffers = 15
Device = Ansi.Sys

I have all of DOS 3.3 in a directory other than my root directory. Should my CONFIG.SYS look something like this:

Files = 15

(Continued on page 92)

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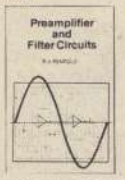

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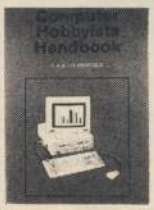

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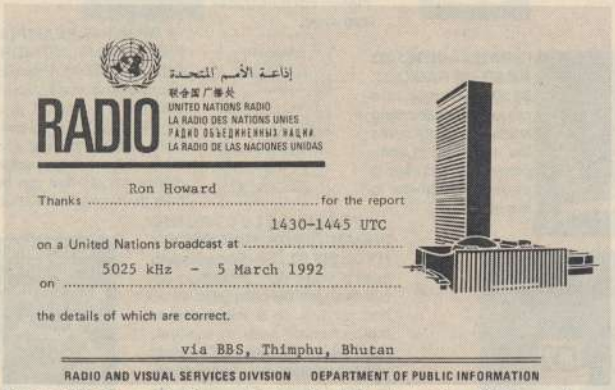
DX LISTENING

By Don Jensen

United Nations Radio

At the end of World War II, the nations of the world, striving to keep the peace that had just been won, banded together to form a global organization that would work to that purpose. After the delegates voted to locate their headquarters in the United States, John D. Rockefeller Jr. gave the UN $8.5 million to buy the site for its headquarters, an 18-acre plaza along the East River, between Manhattan's 42nd and 48th Streets. Forty years ago, the 39-story United Nations Building was completed in New York City, becoming an impressive part of Manhattan's skyline and giving the international organization its permanent home.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LA RADIO DE LAS NACIONES UNIDAS
Thanks Ron Howard for the report
on a United Nations broadcast at 1430-1445 UTC
on 5025 kHz - 5 March 1992
the details of which are correct.
via BBS, Thimphu, Bhutan
RADIO AND VISUAL SERVICES DIVISION DEPARTMENT OF PUBLIC INFORMATION

United Nations Radio replies with this attractive QSL card, showing the impressive UN building in Manhattan, to those SWL's sending correct reception reports of its broadcasts.

Early in its history, the United Nations established a broadcasting service, today called the "Radio and Visual Services Division," whose purpose was to bring UN programming to its member nations and their people around the world.

For many years, longtime SWL's will recall, *United Nations Radio* on shortwave ranked among the major international broadcasters. Its impact was due to the fact that most of the UN broadcasts were aired on the powerful transmitters of the *Voice of America*.

Then, in the mid-1980's, that convenient arrangement broke down. A dispute arose over the leasing of air time on the U.S. government's shortwave facilities. The UN and the VOA came to a parting of the ways. United Nations Radio, of course, did not vanish from the airwaves. Its transcribed programming, in 18 languages and still originating from its New York studios, were, and are, broadcast by local stations in as many as 140 countries.

But on shortwave it was reduced to broadcasting a mere handful of programs via two or three shortwave stations elsewhere in the world. It's not surprising that shortwave DX'ers, returning to listen after an absence of a few years, simply assumed that UN Radio died! It was hard to find its programming.

Things have improved somewhat for United Nations Radio in the 1990's, although the international organization still does not have the on-air shortwave presence of days gone by when their programs were being relayed by VOA transmitters.

Here are some of the broadcasters scheduled to broadcast UN Radio programming on shortwave:

BHUTAN—*Bhutan Broadcasting Service*, English programming to Asia, Mondays, 1630 to 1645 UTC; and Thursdays, 1430 to 1445 UTC, on 5,025 kHz. This is a tough, but possible catch for West Coast North American SWL's.

CHINA—*Radio Beijing*, Chinese-language programs to Northeast and Southeast Asia, Wednesdays, 0900 UTC on 9,590, 9,945, and 15,165 kHz.

COSTA RICA—*Radio for Peace International*, English-language programs to North and Latin America, Monday through Friday at 2150 to 2200 UTC; Monday, Wednesday, and Friday at 2100 to 2115 UTC; Monday and Sunday, 1845 to 1900 UTC; and Saturday and Sunday, 2330 to 2345 UTC, on 7,375, 13,630, 15,030 and 21,465 kHz. For most U.S. and Canadian SWL's, this is your best shot for UN Radio programming in English.

In addition, the UN's *UNESCO Radio* English programs can be heard on Radio for Peace International on the same frequencies, Monday and Thursdays, 2330 to 2345 UTC, Tuesdays, 2100 to 2115 UTC, and Thursdays, 2000 to 2030 UTC.

EGYPT—*Radio Cairo*, Arabic-language programs to the Middle East and North Africa, Sundays at 1645 UTC, on 9,700 and 11,665 kHz.

INDIA—*All India Radio*, UN programming in the Bangla language, Saturdays, 1650 to 1705 UTC on 4,820 kHz. This one is also possible in West Coast North America.

ITALY—*Italian Radio Relay Service*, UN Radio English programs, Mondays thorough Fridays at 0730 UTC; Saturdays at 1330 UTC; Sundays at 0730 and 1700 UTC,

on 7,105, 7,125, or 9,815 kHz. This is the best opportunity for European SWL's.

SIERRA LEONE—*Sierra Leone Broadcasting Service*, programming in English to Africa, Fridays, 2115 to 2130 UTC, and Sundays, 1900 to 1915 and 2115 to 2130 UTC, on 3,316 kHz.

Listeners' reception reports of these programs will be verified by QSL cards. Reports should be sent to United Nations Radio, S-850A, New York, NY 10017.

In addition, UNESCO (the United Nations Educational, Scientific and Cultural Organization) creates its own programming in five languages from its production facilities in Paris. In addition to Radio for Peace (mentioned previously, UNESCO's English programming can be heard on Saturdays from All India Radio at 1346 UTC on 9,565, 11,760, and 11,810 kHz, and at 1930 UTC on 15,110 kHz. On Sundays, a program is aired by Radio Cairo at 2030 UTC on 15,335 kHz.

Reports on UNESCO broadcasts should be sent to UNESCO Radio, 7 Place de Fontenoy, 75007, Paris, France.

Thanks to Ron Howard of Carmel, CA, for forwarding the UN Radio schedule.

IN THE MAIL

We start off this month's mail call with a query from Earle Francoise, New Orleans, LA.

Asks Earle: "While I do have an outdoor antenna for my SW radio, I'm not really happy with it. I think I could be doing better than I am, and I would like to experiment with various types of aerials. Any ideas?"

I think you might find some help, Earle, in a book by veteran Canadian ham radioman, Frank P. Hughes, VE3DBQ. It's called, appropriately enough, *Easy Shortwave Antennas*. The book includes descriptions of more than 50 different antennas, from simple longwires to cubical quads, with some designs for apartment dwellers and those who are limited to indoor antennas as well. It is available from Tiare Publications, P.O. Box 493, Lake Geneva, WI 53147, for $9.95, plus $2 shipping/handling.

Here's an interesting note from Brad Wilson, Key West FL. "I like to look for off-beat SWL'ing. The other day, I got to thinking about a shortwave station in Alaska, which seems to be about as far away as you can get from the Florida Keys and still be in the U.S.A. (Is Hawaii further? I don't know, but I'm more intrigued by the idea of tuning in an Alaskan station.) What, when, and where will accomplish my quest?"

Setting unusual listening challenges for yourself can be a lot of fun. What's the northernmost SW station you can log? The furthest south? How about working your way through the SW alphabet from Argentina to Zambia? (I'll give you a pass on W and X!) Any of the rest of you into this sort of SWL kick? If so, let me know about it.

Now, to Brad's question. KNLS, the "New Life Station" owned by the World Christian Broadcasting Corporation, should fit the bill. It's located at Anchor Point, Alaska, broadcasting on shortwave with a 100-kilowatt transmitter. English-language programming from that religious station can be heard between 0800 and 0900 UTC on 7,365 kHz, or from 1300 to 1400 UTC on 11,580 kHz. Reception reports can be sent to the station at Box 473, Anchor Point, Alaska, 99556.

But just in case Hawaii is further from Key West than Anchor Point, Brad, *World Harvest Radio*, which presently operates shortwaver WHRI from transmitters at Noblesville, IN, has announced that it plans to open a second SW outlet in Hawaii, using a 100-kilowatt Harris transmitter.

In the meantime, of course, Hawaii is represented on shortwave by the time-ticker, WWVH, on 2,500, 5,000, 10,000, and 15,000 kHz, sharing frequencies with WWV in Colorado.

TIME TO TUNE

Let's take a look around the world for interesting shortwave targets.

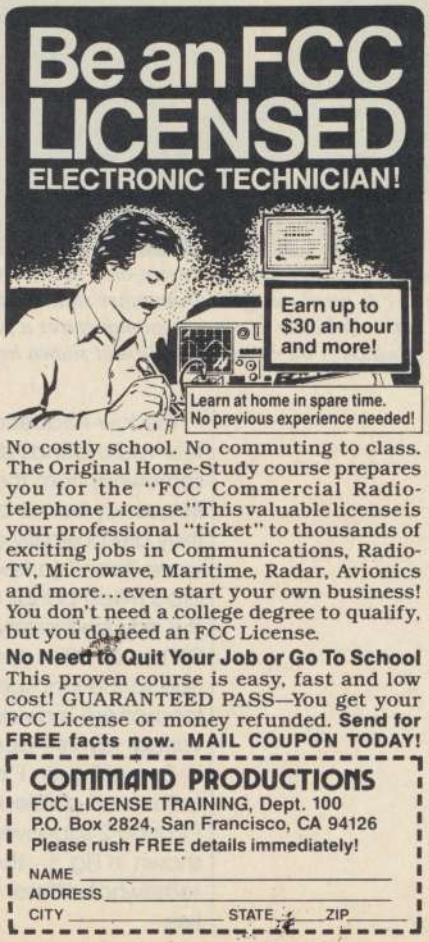
AUSTRIA—13,730 kHz. *Radio Austria International* features English at 0130 UTC, with interval signal, identification, news, and weather.

GUYANA—5,950 kHz. The *Voice of Guyana* is not easily heard, but you might try for it at around 0915 UTC, listening for English-language programming and East Indian music.

KENYA—4,935 kHz. *Kenya Broadcasting Corp.* has an English-language transmission during our evening hours. Look for this one with "3-plus-1" time signals at 0300 UTC, followed by a station identification and a newscast.

SWITZERLAND—21,770 kHz. *Swiss Radio International* has English news and commentary on this channel at 1700 UTC. ■

*Credits: Adie Durden, GA; Ron Howard, CA; Hans Johnson, MD; Marie Lamb, NY; Harold Levison, Rev. Ed Poston, IA; World DX Club, C/O Rich D'Angelo, 2216 Burkey Drive, Wyomissing PA 19610; North American SW Association, 45 Wildflower Road, Levittown PA 19057.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DX'ing The Low Bands

Last month, we looked at a practical antenna for DX'ing the low-frequency, amateur-radio bands; 160, 75/80, and 40 meters. Other types of antennas also work well on those bands, including regular commercial and homebrew "antlers" of more familiar design. You can consult any of the standard reference works for examples of low-frequency antennas (see the boxed copy entitled Further Reading).

Some hams use loop antennas as receive-only antennas on 75/80-meters in order to weed out QRM from other stations and some man-made noise. Palomar Engineers manufactures a pair of loops; one of which is the loopstick-style unit shown here.

The low-frequency, amateur-radio bands differ somewhat from the high-frequency bands because they are basically groundwave "local" (a few hundred miles) bands during the day, and pretty decent DX bands after dark. That's due to the ionosphere. The ionosphere is divided into various layers—designated D, E, and F (with F being further sub-divided into the F1 and F2 sub-layers) as shown in Fig. 1—that have somewhat different properties.

However, those layers are well-defined only in textbooks; and even in textbooks, the location above the Earth's surface where these layers are said to be located tend to vary. In addition, the layers don't have sharply defined boundaries, but rather blend into one another. Thus, the division into layers is somewhat arbitrary.

The D-layer (the lowest layer in the ionosphere, existing from approximately 30 to 50 miles above the Earth's surface) is not ionized as much as higher layers because all forms of ionization-causing solar energy is severely attenuated by the layers above the D-layer. The reason for that is that the D-layer is much denser than the E and F layers, and that density of air molecules allows ions to quickly recombine to form electrically neutral atoms.

Thus, the extent of D-layer ionization is directly proportional to the height of the Sun, which achieves maximum intensity at midday. The D-layer exists mostly during the warmer months of the year because of both the greater height of the Sun above the horizon and the longer hours of daylight. However, the D-layer almost completely disappears after local sunset, although some observers have reported sporadic incidents of D-layer activity for a considerable time past sunset.

For low-frequency DX, the problem is that the D-layer absorbs large amounts of medium-wave and short-wave signals. In fact, it does so to such an extent that signals below about 7 MHz are completely absorbed by the D-layer. Therefore, on 75/80 meters, only groundwave propagation occurs during the daylight hours, especially during the summer months. But after dark, the D and E layers disappear, and the F1/F2 layers change in altitude and fuse into a single F layer. When that happens, the maximum usable frequency (MUF) drops precipitously, so the bands from 20 meters and up die rapidly. But the lower bands are still below the MUF, and are no longer afflicted with D-layer absorption. As a result, the DX comes rolling in.

In fact, during the early evening hours, those very popular bands come alive with too many signals! On the 40-meter band, the problem is compounded by the fact that international broadcasters use the same frequencies as hams, causing a real mess. Another problem with the early evening hours is local electromagnetic interference (EMI).

While neighbors and family members sometimes gripe about TVI and BCI from ham transmitters, they can't quite conceive of the problem in reverse.

The low bands are terribly afflicted with noise from electrical sources. For instance, lightning storms produce high levels of natural noise and interference in those bands. In addition, QRM (man-made interference) from light dimmers, electric motors, and many other appliances raise havoc with our reception. And then there

are those "danged" television sets. There are actually two problems with TV sets. First, there is the horizontal oscillator, which operates on 15,734 Hz. Because those signals are very powerful and nearly squarewaves, they generate harmonics that reach all the way into the HF region ... and they are still very strong in the 160- and 75/80-meter bands. Those harmonics will produce strong birdies every 15.734 kHz up and down the band.

Videotape recorders are also a pain. Their 3.58-MHz color oscillator often radiates, despite the FCC sticker on the back of the machine. Videotape recorders produce repeated sidebands up and down the band from 3.58 MHz, which sound a bit like birdies and/or like frying eggs and hash. You can actually tell when a popular TV show is on by listening to the collective 15.734 kHz and 3.58 MHz crud on 75/80 meters!

As the evening wears on, however, the QRM level drops for one of two reasons; other hams go off the air, leaving the band a lot freer, and the other people go to bed, turning off their TV sets and light dimmers. The crud level drops rapidly after 11 PM.

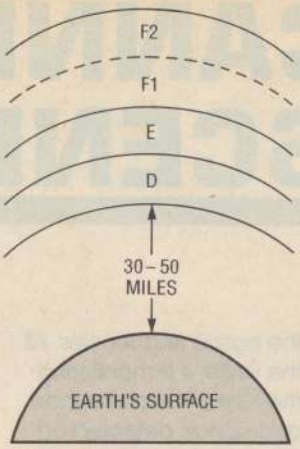


Fig. 1. The ionosphere is divided into various layers—designated D, E, and F (with F being further sub-divided into the F1 and F2 sub-layers)—that have somewhat different properties.

Interesting things occur on the low bands as the evening wears on. The skip begins to lengthen, so that by midnight, transcontinental contacts on 75/80 meters become easy. Indeed, there are 75/80-meter DXCC (100-contries worked) award winners. (I bet they're a bunch of night owls!) I've seen a lot of European DX rolling in on 40 meters in the early evening, but after midnight, the skip starts rolling east into UA-land (Russia) and the far east. (I can recall working what I first thought was a "K2" on 40 meters just before dawn, only to find on the "go back" part of the contact that it was a "VK2" in Australia.)

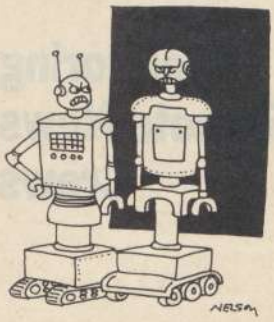
All of those bands become more active and longer reaching after midnight but before dawn.

LOOP ANTENNAS

In the June 1992 column, we looked at loop antennas. Loop antennas work very well in the lower frequency bands, in fact much better than on higher frequencies. Some hams use loops as receive-only antennas on 75/80 meters in order to weed out some man-made noise and QRM from other stations. Those loops are very directional, so they can be used to null-out strong local signals, thereby improving the signal-to-noise-ratio (SNR) enough to uncover weaker DX signals lying below the band-busting *kilomegawatt* blow torches on the same or nearby frequencies. That is especially easy to do if your transceiver is one of those that has a separate optional receiver-antenna input. Otherwise, you'll have to use a loop controlled by a relay, or a separate receiver.

Palomar Engineers (P.O. Box 455, Escondido, CA 92033; Tel. 619-747-3343) manufactures a pair of loops; one of which is a square loop, while the other is a loopstick style. Both loops are designed to be used with Palomar's LA-1 loop amplifier.

Well, that's all the room we have for this time. Be sure to join us again next month—"same time, same station!" ■



"Yeh! And you have chips for brains."

FURTHER READING

Practical Antenna Handbook
Joseph J. Carr
TAB/McGraw-Hill
Cat. No. 3270
TAB Books
Blue Ridge Summit, PA 17294
800-233-1128

Receiving Antenna Handbook
Joseph J. Carr
HighText (DX/SWL Press)
7128 Miramar Road, #15
San Diego, CA 92121

ARRL Antenna Handbook (any edition)
ARRL, 225 Main Street
Newington, CT 06111

Radio Handbook (any edition)
Bill Orr, W6SAI
Sams/Prentice-Hall Computer Publishing
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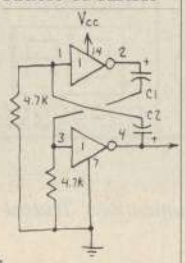

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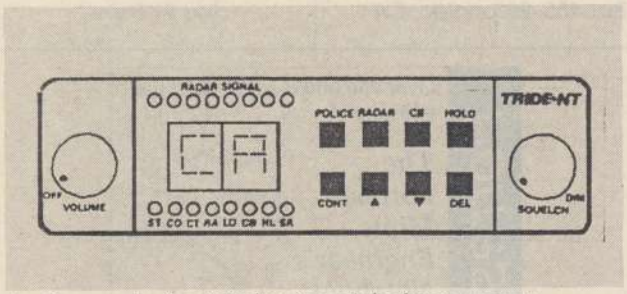
SCANNER SCENE

By Marc Saxon

Monitoring Remote News Crews

Maybe Santa will bring you a Trident this year. "What's that?," you might ask. "That's not on my list!" Well, perhaps it should be.

The *Trident* is a triple-threat radio, with a state-by-state police-radio scanner, a CB receiver, and a two-band (X- and K-band) radar detector all rolled into one. Come to think of it, the Trident also features a weather channel and a mobile-repeater setting that detects when patrol cars with mobile repeaters are in the area.



Ace Communications' Trident is a triple-threat scanner.

The scanner section is preprogrammed for all allocated state, county, and city police frequencies in the 48 contiguous states. You select the state you want from the front-panel display, and then instruct the scanner to monitor only the state, the state and county, or the state, county, and city channels. You can even tell the Trident to check the local highway CB channel for information after two passes through the list of police channels. If there's nothing on CB, the unit switches itself back to the police frequencies. All the while, it is monitoring the X and K radar bands, and signals detected on either band will interrupt any other signals to bring you a radar alarm.

Despite all that it can do, the Trident is quite simple to operate. Pushbuttons are used to select the radar, scanner, or CB-receive mode. It scans at the rate of 60 channels per second. Slew up or down to select state or CB channel. You can lock out up to 500 channels in each state. There's also a light dimmer. The unit comes with a coiled cigarette-lighter cord, Velcro dash mounts, a visor mount, and a flexible antenna.

The Trident carries a suggested retail price of $199. For more information, contact Ace Communications Monitor Division, 10707 East 106th Street, Indianapolis, IN 46038; their phone number is 1-800-445-7717.

GETTING REMOTE

Many radio and TV broadcasters have a need for two-way communications. Some typical uses include dispatching reporters and camera crews to the scene of a breaking story, and talking to traffic reporters in helicopters, planes, and cars. Radio stations often send a broadcasting van to a store, mall, fair, carnival, parade, sporting event, etc., for a "remote" pickup.

Scanner owners have the ability to tune in on the frequencies used by those broadcast services. Several bands are used in the range of scanners. The most popular frequencies are 161.64, 161.67, 161.70, 161.73, and 161.76 MHz; also used are 450.00 to 451.00 MHz (in 12.5-kHz steps) and 455.00 to 456.00 MHz (in 12.5-kHz steps). In selected areas, 166.265 and 170.15 are used as well. In addition, frequencies from 152.87 to 153.35 MHz (in 60-kHz steps) are assignable on the basis of non-interference to industrial stations on those frequencies. It might also be productive to search 152.8575 to 152.3625 MHz (in 50-kHz steps) and 161.6275 to 161.7725 MHz (50-kHz steps) to see if anything else turns up in the way of broadcasters.

Particularly interesting communications can occur when the station's van is doing a remote broadcast. The commercials and recordings often come from the main studio. They may be transmitted, along with cues, orders, and other related communications, on one of these frequencies for the benefit of the personnel in the van. The 450–451-MHz band is popular for that.

The van itself may be monitored on another frequency (usually in the 455–456-MHz band) with the "live" programming material for broadcast. What's most interesting takes place during the music and commercials, when the van

personnel get a few minutes to chit-chat with the studio people, discussing technical problems and scheduling matters, and just kidding around. Similar chatter can often be heard on the channels used to communicate between the studios and airborne traffic reporters.

One enlightening thing that you learn from monitoring is that some of the airborne drive-time traffic reports that you think are "live" are actually broadcasts that had been recorded by the studio crews as much as five minutes earlier. Also interesting is to hear the jovial airborne traffic reporters from various competing local stations comparing notes and joking with one another between their reports. Listen for them on VHF aeronautical frequencies such as 122.75, 122.9, 123.025, and 123.45 MHz.

In larger cities, radio and TV news crews are heavily dispatched on the auxiliary broadcast frequencies. That can be quite exciting. A number of stations have recently taken to scrambling their signals to prevent competing stations from listening in and then scooping them on their own stories.

If you haven't tried these frequencies, it's worth a shot. It could prove to offer many interesting insights.

GET THE IMAGE?

John Felsher, of Redding, CA, wrote to say that he is picking up cellular phone calls in the 894–914-MHz frequency range. He thought that was pretty odd, since those frequencies aren't allocated for cellular use. John wonders if we have any thoughts on this.

Our best guess is that this is the result of John's scanner picking up "images" of the cellular band. Suffice it to say that programmable scanners are a sufficiently complex tangle of oscillators, IF's, and other circuits to allow many scanners to be able to receive phantom "image" signals where they don't seem to belong. It doesn't mean that there is anything malfunctioning in the scanner; it's simply the way that scanners were designed. It's what allows two-meter-band (146-MHz) ham repeaters to be monitored around 167 MHz on many scanners. Where the images will pop up depends on the IF frequency used in the design of a particular scanner, with 10.7 and 10.8 MHz being the usual IF frequencies causing those images. Some newer scanners have go to 611-MHz IF frequencies to avoid the image problem.

Remote-pickup broadcast vans can lead to some exciting scanning.

But images may not be all bad. In scanners that have the 869–894-MHz cellular band locked out, images can be a viable way around that lockout. In scanners that use a 10.7-MHz IF frequency, the image of the cellular band should show up from 890.4 to 915.4 MHz. For scanners with a 10.8-MHz IF frequency, the image cellular band runs from 890.6 to 915.6 MHz.

Send your questions, comments, and frequency data to *Scanner Scene*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

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Hints & Kinks for the Radio Amateur

edited by Robert Schetgen, KU7G

Intended to help radio amateurs reach their peak "ham-ability," this book provides a collection of the best tips, suggestions, and projects from the "Hints and Kinks" column in *QST* magazine. The 13th edition, which covers the years 1987 to 1991, is filled with information to help hams make the most of their stations and adopt the most effective operating procedures. Included are antenna projects, with complete instructions for building a sigma loop, a double half-wave loop, a two-meter umbrella antenna, and a two-band loop. Other construction projects include generator projects for Field Day and emergency operations, a baby-bottle balun, LED's to light a call-sign badge, resonant speaker enclosures for CW, and an audio VCO for audible metering. For those who tune their radios too slowly, the book explains how to weight the knob for "spin" tuning and how to use mercury switches to change frequencies as you tilt your head. New hams as well as experienced amateurs will appreciate information on how to get the most out of rechargeable radios; how to build indoor and outdoor antennas; the right way to install ground rods, radials, and connectors; how to "tune" new antennas; and how to find parts for simple projects. For experienced builders, the book offers design tips and discussions of diodes for power supplies, RF probes and detectors, stable high-voltage metering, inductor-core materials for VFO's, and a "fast-attack" AGC circuit.

Hints & Kinks for the Radio Amateur costs $9.00 and is published by the American Radio Relay League, 225 Main Street, Newington, CT 06111.

CIRCLE 91 ON FREE INFORMATION CARD

THE ABCs OF DMMS

from John Fluke Mfg. Co.

This updated, 16-page booklet offers a short course on the operation, capabilities, and selection of digital multimeters. Designed for use as a quick reference guide as well as a selection guide, it features sections covering the common uses of a DMM—AC and DC voltage measurements, AC and DC current measurements, and resistance, continuity, and diode tests—as well as sections on multimeter safety and multimeter accessories. Each section of the booklet is clearly illustrated and includes a glossary of electronic and multimeter-related items. New tools featured in the booklet include the Fluke 70 Series II

family of DMM's. The eight meters in the 70 Series II include enhanced versions of the existing five models of the Fluke 70 Series as well as three all-new models. The Series 10 family of DMM's, a low-priced line of multifunction meters, is also featured in the booklet.

The ABCs of DMMs is free upon request from John Fluke Mfg. Co., Inc., P.O. Box 9090, M/S 250-E, Everett, WA 98206; Tel: 800-87-FLUKE.

CIRCLE 92 ON FREE INFORMATION CARD

WORD FOR WINDOWS DESIGN COMPANION For Version 2

by Katherine Shelly Pfeiffer

Combining a discussion of Word for Windows' graphics capabilities with valuable instruction on effective design, this book helps the reader create attractive visuals. The book explores the desktop design potential of this popular word-processing program. It shows novices the basics of

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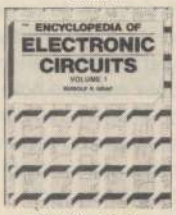

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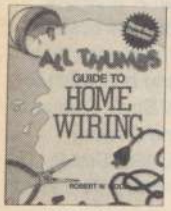

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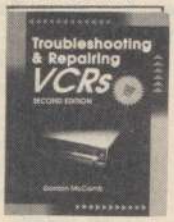

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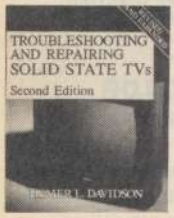

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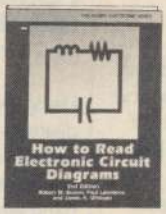

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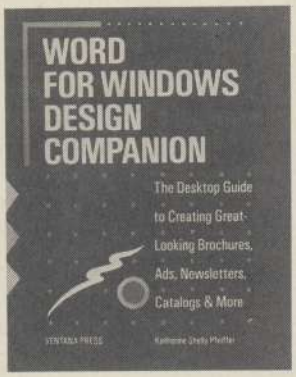
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The Desktop Guide to Creating Great-Looking Brochures, Ads, Newsletters, Catalogs & More
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software recommendations and advice on using those procedures. All of the book's numerous illustrations were produced using Word for Windows. The book's step-by-step instructions and tips on production, font manipulation, printing techniques, and more, help readers to produce similar illustrations on their own.

Word For Windows Design Companion costs $21.95 and is published by Ventana Press, P.O. Box 2468, Chapel Hill, NC 27515; Tel: 919-942-0220; Fax: 919-942-1140.

CIRCLE 93 ON FREE INFORMATION CARD

1992 AMATEUR RADIO MAIL ORDER CATALOG AND RESOURCE DIRECTORY

from Hart Publishing

The fourth edition of this sourcebook contains 220 pages and more than 1200 entries of mail-order products and services for hams. The catalog is categorized and alphabetized into easy-to-find headings, from "Antennas" to "Weather Instruments." Each listing includes complete ordering information along with a description of the product or service. The catalog also features some non-radio-related listings, such as environmental-organization BBS's, and other informative sources are listed under "Catalogs and References." The complete "Ham–Soft Shareware Catalog" is included for those hams who are looking for inexpensive software. The Resource Directory portion of the catalog contains listings of free catalogs and those available for a fee, radio clubs, VEC's, amateur-radio bulletin services, foreign radio magazines, and BBS's. To maintain accurate listings, the catalog is updated and published twice each year, in January and July.

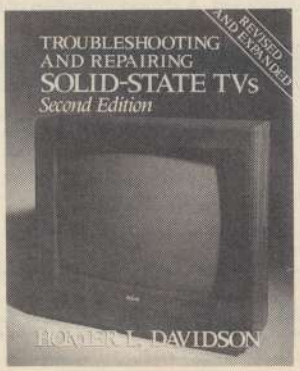
The 1992 Amateur Radio Mail Order Catalog and Resource Directory costs $20 ($25 outside the U.S.) for a one-year, two-issue subscription. The single-issue price for the July 1992 issue is $12. The catalog is published by Hart Publishing, 767 South Xenon Court, Suite 117, Lakewood, CO 80228; Tel: 303-987-9442.

CIRCLE 84 ON FREE INFORMATION CARD

TROUBLESHOOTING AND REPAIRING SOLID-STATE TVs: Second Edition

by Homer L. Davidson

The revised edition of this workbench reference is packed with case studies, photographs, and diagrams for every type of TV circuit, to help electronics hobbyists and professional technicians isolate and repair virtually any TV problem quickly and easily. The book provides practical information on how to troubleshoot and repair the latest solid-state circuitry used by major television manufacturers. With a combination of technical expertise and easy-to-read non-technical writing, the book describes the warning symptoms of solid-state TV problems, and zeros in on the probable circuits and individual components that are causing the malfunction. The second edition has been expanded to cover high-definition television, stereo-sound circuitry, modular chassis, and large-screen models. The book explains how to repair such problems as defective horizontal-sweep circuits, faulty remote controls, high- or low-voltage power supply, brightness and picture-tube problems, and defective tuners. In addition, it explains how to locate defective transistors and color processors in various color chassis.



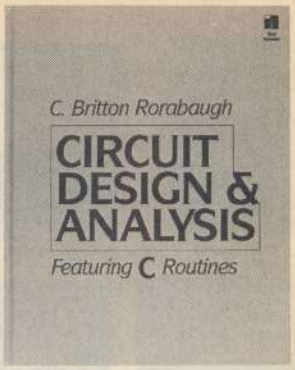
Troubleshooting and Repairing Solid-State TVs: Second Edition costs $24.95 and is published by TAB Books, Division of McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850; Tel. 800-822-8138.

CIRCLE 98 ON FREE INFORMATION CARD

CIRCUIT DESIGN & ANALYSIS FEATURING C ROUTINES

by C. Britton Rorabaugh

Using this book and its included diskette, anyone equipped with an IBM-compatible personal computer and the C programming language can take advantage of the same professional-level diagnostic tools used by experts to analyze complex electronic circuitry. Unlike prepackaged, general-purpose analysis programs, the "ready-to-compile" C routines presented in this book/disk package allow readers to configure customized, streamlined programs offering great speed and flexibility, while using less computer memory. Starting with an extensive review of the basics of circuit analysis, the book goes on to present a range of powerful computer-aided analysis and synthesis techniques including algorithms for solving matrix equations, computer representations of network topologies, various approaches for constructing a network's system equation, the computation of transient responses of linear networks, computer synthesis of passive networks, computer generation and manipulation of symbolic network functions, sensitivity analysis, and special analysis techniques for nonlinear networks. Complete source code listings for non-IBM users are also included.



Circuit Design & Analysis Featuring C Routines costs $49.95 for the hardcover book and diskette, and is published by McGraw-Hill Book Company, Professional and General Books, 11 West 19th Street, New York, NY 10011; Tel: 800-2-MCGRAW.

CIRCLE 96 ON FREE INFORMATION CARD

LASER CATALOG

from MWK Industries

The word "laser" might call to mind science-fiction images of ray guns and the like, but in reality, lasers are used in many less flashy devices used in everyday life, from CD players to medical equipment. Hobbyists and experimenters can find their own applications, using the large selection of reasonably priced lasers offered in this 30-page catalog. Products include laser pointers, laser diodes, and much more. In addition, the catalog includes an assortment of laser plans and books.

The Laser Catalog is free upon request from MWK Industries, 198 Lewis Court, Corona, CA 91720; Tel: 800-356-7714 (in CA, 800-58-LASER); Fax: 714-278-0562 (in CA, 714-278-4887). ■

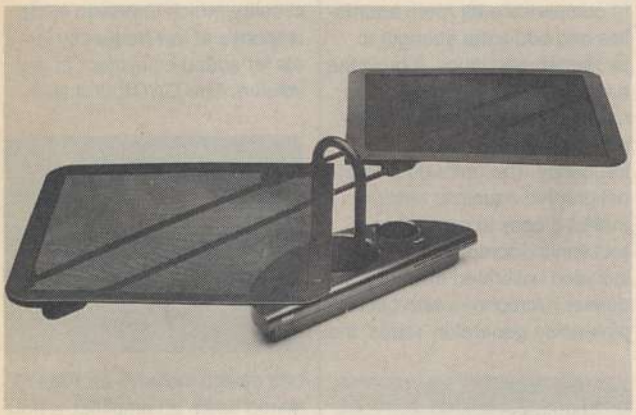
CIRCLE 85 ON FREE INFORMATION CARD

NEW PRODUCTS

Indoor Television Antennas

The days of the rabbit-ear antenna are over, yet you don't have to pay the high price of cable TV to get good reception, according to *Terk Technologies*. The alternatives Terk offers are the *Models TV20* and *TV10* indoor television antennas, which deliver crystal-clear VHF and UHF TV reception, and look good while doing so. (The TV20 has won both the Chicago Athenaeum "Good Design" Award and the Electronic Industries Association's Innovation's '92 Design and Engineering Award.) With a maximum height of just 5¼ inches, the antennas give users great flexibility in the placement of their TV sets.

The TV20 uses two tuned



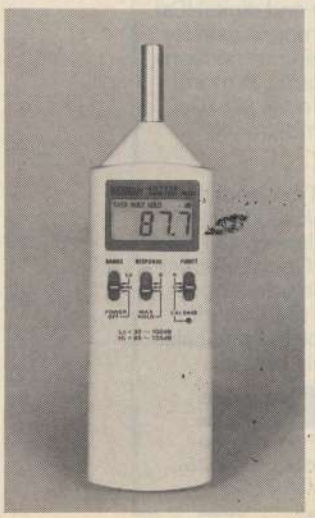
elements configured in a "complementary-symmetry" design, combined with an adjustable low-noise, high-gain amplifier, to yield the best possible reception. The two wing-like reception elements are arrayed to minimize the need for user manipulation. A built-in filter cuts down on "snow." A cable/antenna selector allows viewers to switch between the antenna and the local cable source, or any external RF source. The built-in amplifier can also be used to restore the quality of video degraded by poor cable leads. For use in areas closer to the broadcast source, the TV10 features the same complementary-symmetry design, but without the amplifier. Neither antenna is affected by the proximity of the human body, so users avoid the frustration of getting a good picture that degrades as soon as they sit back down to watch it.

The TV10 and TV20 indoor TV antennas have suggested retail prices of $24.95 and $79.95, respectively. For more information, contact Terk Technologies Corp., 233-8 Robbins Lane, Syosset, NY 11791; Tel: 516-942-5000; Fax: 516-942-TERK.

CIRCLE 101 ON FREE INFORMATION CARD

DIGITAL SOUND-LEVEL METER

The *Model 407735 Digital Sound Level Meter* from *Extech Instruments* lets users select A or C frequency weightings for a wide measurement range of 30–135-dB. Two ranges are available: low (30–100-dB) and high (65–135-dB) with a 0.1-dB resolution. The large 3½-digit LCD readout provides a choice of slow or fast response time, and features a peak-hold function that displays the highest reading. A built-in continuity check function, auxiliary AC and DC conditioned outputs, and a condenser microphone are also featured. The sound-level meter comes with a hard vinyl case and a 9-volt battery.



The Model 407735 digital sound level meter costs $199. For additional information, contact Extech Instruments Corporation, 335 Bear Hill Road, Waltham, MA 02154; Tel: 617-890-7440; Fax: 617-890-7864.

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MULTI-FUNCTION AUDIO COMPONENT

You can replace up to five other units with *Sonance's AC-1* multi-function component. The device can sequentially activate a series of amplifiers or other components via switch or line-level sensors. That allows you to, for example, activate a home theater or other complex multi-amplifier system at the touch of a button, without the massive power draw usually associated with a single-touch power up.

When the front-panel switch has been activated, up to four components can be powered up at 2½-second intervals. When the unit's sensor detects no audio signal for about four minutes, it returns to a stand-by mode and all connected components are turned off.

The AC-1 acts as a distribution amplifier with four sets of stereo line-level outputs, allowing a single stereo input (usually from a preamp) to be distributed to up to four amplifiers, at different volume levels. Front-panel LED's verify the status of each amplifier, and trim controls allow independent right- and left-channel adjustments.

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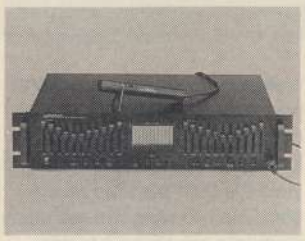
The multifunction unit also functions as a high-quality power conditioner that provides full three-stage protection of sensitive audio and video equipment. In addition, the AC-1 is equipped with a relay, dry-contact closure, rear-panel terminal to provide an activation trigger for an external advice, such as the motor for a video screen.

The AC-1 has a suggested retail price of $350. For more information, contact Sonance, 961 Calle Negocio, San Clemente, CA 92673; Tel: 800-582-7777; Fax: 714-361-5151.

CIRCLE 103 ON FREE INFORMATION CARD

GRAPHIC EQUALIZER/ SPECTRUM ANALYZER

Because most listening rooms and recordings are less than perfect, the *EQ Twelve* graphic equalizer/spectrum analyzer from *AudioSource* is designed to compensate for room anomalies and add extra strength to lackluster recordings. It provides a full ten bands of equalization as well as a professional method for analyzing each frequency. The unit's dual-channel graphic-equalizer section makes it easy to precisely correct sonic discrepancies. The included calibrated electret condenser microphone with built-in pink-noise generator "reads" the



acoustics of the listening environment by using pink noise. Users can then manually adjust the precise equalization settings. The multi-function spectrum analyzer provides a visual display of the relative signal levels for each of the ten accessible frequency bands—30, 60, 120, 240, and 500 Hz, and 1, 2, 4, 8, and 16 kHz. An eleventh row of LED's indicates the average total output for the left, right, or both channels simultaneously. Bright LED's on all sliders and switches indicate exact settings at a glance. For those concerned that adding an equalizer to their system will cost them a precious tape or accessory loop, the EQ Twelve provides a host of inputs that facilitate tape equalization, proper impedance matching of audio/video systems, and tape-to-tape dubbing. With dual tape loops, the user can use the unit to add an input/output loop to their system.

The EQ Twelve has a suggested retail price of $299.95. For more information, contact AudioSource, 1327 North Carolan Avenue, Burlingame, CA 94010; Tel: 415-348-8083; Fax: 415-348-8083.

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BOOKSHELF STEREOS

Two bookshelf stereo systems from *Sanyo* feature a streamlined look and "BASSXPANDER" circuitry, which improves audio response at low-frequency levels for added enjoyment at any volume. The *GCD1000's* all-in-

one design includes an AM/FM stereo tuner, an amplifier, a double cassette recorder, and a CD player. Up to 24 tracks can be programmed on the front-loading CD player, and monitored on the LCD readout. The double cassette recorder offers high-speed synchronous tape-to-tape dubbing and continuous play. The system can be connected to a video source via the video inputs, and a stereo headphone jack.

The *GCD2000* (pictured) steps up to a five-disc, top-loading carousel CD changer with 32-track programmability, fade, and disc-skip functions. The PLL digital synthesized tuner offers 36 station presets and extended AM-band reception. A 19-key remote control is also included.

The GCD1000 and GCD2000

bookshelf stereo systems have suggested retail prices of $239.99 and $349.99, respectively. For more information, contact Sanyo, 21350 Lassen Street, Chatsworth, CA 91311-2329; Tel: 818-998-7322; Fax: 818-701-4149.

CIRCLE 105 ON FREE INFORMATION CARD

FREQUENCY GENERATOR

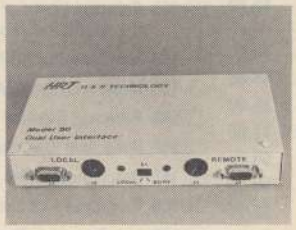
The *Dial-A-Freq Model F-120* from *Vann Instruments* generates any frequency from 29 Hz to 120 MHz when the user enters the desired frequency on its pushbutton keypad. The frequency selected and output is displayed on a 16-character LCD readout. The Dial-A -Freq is housed in a 4×6×1½-inch aluminum case, and is powered by a 9-volt wall adaptor. Two BNC connector outputs are for the true and complement of the generated frequency at advanced CMOS 5-volt logic levels, capable of driving a 50-ohm load. The microprocessor-based instrument performs the frequency synthesis via a voltage-controlled oscillator with phase-locked loop and integrated loop filter.

The Dial-A-Freq F-120 frequency generator costs $249. For further information, contact Vann Instruments, 1046 Vassar NE, Albuquerque, NM 87105; Tel: 505-265-2498; Fax: 505-268-9722.

CIRCLE 106 ON FREE INFORMATION CARD

DUAL-USER INTERFACE

Two monitors and/or keyboards can be connected to a single personal computer using *H&R Technology's Model 90 Dual User Interface* (DUI), which buffers the video signal for simultaneous display on two monitors and routes the input from keyboards to the computer. The interface can be used in a variety of situations where a computer must be shared from



two locations, including in offices, on factory floors requiring remote monitors and/or keyboards, to expand the capacity at a node of a LAN or other network, or to split the video for display on multiple monitors. The Model 90 connects to an IBM-compatible PC in minutes and requires no external power supplies or special software. The second monitor and keyboard can be located up to 50 feet away from the unit. The Model 90 provides compatibility with Super-VGA, VGA, EGA, CGA, or MDA monitors. Each keyboard gains access to the computer when it is typed on. While in use, a preset time-out delay prevents the other keyboard from interfering. The unit also features a privacy switch in order to manually disable the remote keyboard and monitor when sensitive data is being handled by the local station.

The Model 90 Dual User Interface ranges in price from $260 to $280, depending on monitor compatibility. For more information, contact H&R Technology, 1506 Brookhollow Drive, Suite 106, Santa Ana, CA 92705; Tel: 714-641-6607; Fax: 714-966-1770. ■

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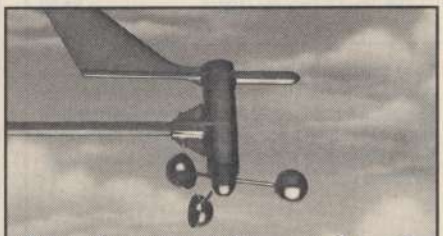

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TALKING COMPASS

(Continued from page 44)

on the chip at once by pointing the compass north and holding the push-button down all the time. It will playback all recorded compass directions, in order. Then it will be in an overflow condition and cannot be pulsed to playback again. If that happens, just turn the power off and then back on again to reset the circuit. Likewise, should the Talking Compass ever quit playing back, it is probably in an overflow condition; as described previously, just turn the power off and then on and the unit should resume working normally once again.

If the battery runs down, the chip will not record; at that point, it will playback only, and the recorded message will eventually sound drawn out. That's a built-in low-battery warning feature.

Other Uses. Since the Talking Compass is capable of recording a full 16 seconds of voice communications, it can also be used as a message center. To use the unit as a message center, simply place S3 in the record mode, and with the unit facing north, press S2 and begin speaking. The unit will stop recording when S2 is released, or it will automatically shut down after 16 seconds has elapsed and its memory is full.

After recording your message, reset the unit by simply turning it off and on again. Then place S3 in the playback mode, and with the unit facing north, press S2. Note that in order to recover the message, the unit must be facing the direction in which the message was recorded. Of course, the unit can not be used as a compass that way, but it is a simple matter to re-record the compass points later.

You could also record two 8 second messages; one with the compass facing north and one with the compass facing south. Each message is played again by pointing the compass in the direction that the message was recorded and pressing S2.

As you can see, there are several ways to use the Talking Compass. You may want to "can" a few special phrases for use at an appropriate time. Don't let it get you in trouble, though! ■

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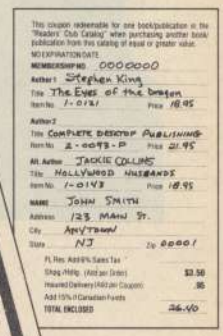

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INSTALLING CAR STEREOS

(Continued from page 38)

of strange noises and whistles whenever a key is pressed. In a window antenna, simply lay the calculator against the window glass. If an antenna is defective, it is better to replace the antenna rather than try to repair it.

If there is noise in the radio and/or tape deck when the vehicle is running, the problem is engine interference. That is sometimes very hard to remedy, but often the noise can be minimized by observing a few installation rules: Ground your stereo through one point (at the chassis of the head unit itself to the vehicle chassis via the metal back strap as mentioned earlier). If grounds are separately run from each unit or accessory to different places on the vehicle, sometimes the electrical system on the vehicle will generate noise that can be picked up between these points. Furthermore, use good-quality shielded cables to run audio between the head unit, the amplifier, and other accessories.

All wiring should be as short as possible; sloppy wiring that is left all wound together in a large ball makes a great transformer into which annoying interference can be induced. Also keep your power leads separate from your low-level audio wiring. Similarly, keep your wiring separate from harnessing in the car itself. Try not to get your wiring too close to the computer system, clocks, and controls.

If none of these tips works, disconnect the antenna from the unit. If the interference disappears, try to reroute the antenna wiring. Try to hook the power leads to different 12 volt sources, or try to reroute the wiring.

In cases of severe interference, there are some noise-suppression devices on the market that might help. Check with your car-stereo dealer for the device that might be most likely to help in your specific instance.

If you choose to tackle the job of a car-stereo installation, we think that you will find the combination of a great-sounding system and the pride of accomplishment in doing it yourself to be well worth the effort. And by following the tips presented in this article, we think you'll find that installing a car-stereo system need not be an overwhelming task. ■

KIT BUILDING LIVES

(Continued from page 41)

unit is completed, frequency selection is accomplished through the use of a 12-position rotary switch (front-panel mounted) that selects any one of 12 pre-programmed frequencies over the range of 140 to 180 MHz. These frequencies as well as the offset are determined by the placement of diodes (type 1N914 or their equivalent) installed in two diode matrices located on the PC board proper. The smaller matrix determines the offset (if required) and the larger matrix provides the base for the user-defined frequencies.

A little over 15 years ago, ICOM produced a similar transceiver that used a diode-matrix/switch-selected frequency scheme. However, to build ICOM's unit required a substantial amount of knowledge on the part of the builder as the programming instructions and information were minimal.

Ramsey, however, did not make the mistake of over-estimating the knowledge or skills of potential kit builders. Rather, they devoted many pages to explaining in detail how the matrix works, how it selects frequencies and offsets, and exactly how one calculates the required diode placement for a specified frequency. There is even a BASIC program included to determine the diode requirements and placement. To help you determine what frequencies may be of interest, there is also a listing of the most common and frequently used repeater pairs (transmit and receive) and the frequencies for both the U.S. Space Shuttle as well as the Russian Space Station *MIR*.

The builder has the option of filling all twelve of the switch positions, or—by using a simple external programming switch/diode assembly and a length of flat cable—adding a "remote" feature with virtually no limitations. To elaborate further; the PC board has provisions for installing a user-supplied flat cable leading to external switching in addition to the 12-position rotary switch. So for us, it would be possible to have the most frequently used frequencies, one channel dedicated to receive our local National Weather Station (NOA), and any other frequency in the 140–180 MHz range remotely programmed via a simple DIP switch.

Final Testing. To test and align the FX-146, you have to program-in a local frequency. Your DVM and some non-metallic alignment tools will suffice to adjust the receiver section. After making some adjustments to produce the right measurements at nine or so test points, you simply peak some settings to achieve the best reception. We used the local NOA weather broadcast for these adjustments.

To peak the RF output, you will need a second 2-meter receiver (such as a scanner or a transceiver borrowed from a friend) and a valid ham license to adjust the deviation potentiometer. When you've reached this stage, you'll need a 50-ohm dummy load and some method of measuring RF output. As you can see in Fig. 1, we've made up a relatively simple circuit that will allow you to use your DVM to measure output. In lieu of the circuit, you could borrow a combination RF/SWR bridge/dummy load from a CB'er and accomplish essentially the same task. During this phase of testing, you aren't so much interested in specific values of output, but rather obtaining *maximum* RF output. This is done by adjusting capacitors and stretching coils.

Summary. It was obvious, at least to us, that the Ramsey FX-146 transceiver kit met all of our requirements. Furthermore, it gave us the satisfaction of actually building a sophisticated VHF transceiver ourselves; an active learning experience that added to our knowledge of electronics; and provided a cost-effective base to begin our adventures in digital communications.

Heath may have abandoned the kit market for greener pastures, but Ramsey Electronics has taken up the challenge and is alive, well, and producing kits that don't just entertain, they educate you in the most interactive and painless manner possible. If that sounds appealing and you'd like more information about the FX-146 Two Meter FM Transceiver kit and its options, you can contact Ramsey Electronics Inc., (793 Canning Parkway, Victor, NY 14564; Tel. 716-924-4560) directly or circle No. 121 on the Free Information Card. ■

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ANTIQUE RADIO

(Continued from page 65)

riveted), none of the irons I had on hand would do the job—not even an old-fashioned 60-watt American Beauty complete with asbestos cord.

Anticipating a similar problem on reinstallation, I recently went shopping for a higher-wattage unit. What I hoped to find was a Weller solder gun similar to one I had last used about 30 years ago. There was nothing like it, I thought, for packing a hefty dose of heat into a small tip. And I remembered the instant-heating feature and handy built-in work light with great fondness.

I was afraid that anything heavier than a pencil iron might be difficult to obtain in today's world of solid-state electronics, but I was very pleasantly surprised.

One tree can make 3,000,000 matches.

One match can burn 3,000,000 trees.

Ad Council

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Weller guns are still available, as well as similar units by Lenk and other manufacturers. You won't be likely to find one in an electronics store any longer, but hardware and home-center stores still stock them. In fact, some hardware stores still carry old-fashioned high-wattage irons (at astronomical prices).

After doing a bit of comparison shopping, I settled on a Weller "Universal," which is a dual-heat (100/140-watt) model. There is a smaller Weller, a single-heat model of about 90 watts, and some stores had it on special at attractive prices (under $20). But I decided not to risk being underpowered.

Once I tried my purchase on the Sky Buddy, I was very glad I'd been conservative. Using the "high" setting, I was able to resolder the ground braid quite handily—but only after waiting a few minutes for that massive joint to heat up. I don't think the 90-watt job would have made it.

After reacquainting myself with the Weller gun, I'd go so far as to say that every serious antique-radio hobbyist ought to have one. You never know when you're going to need a blast of heat to redo a chassis ground or solder a heavy bus-bar in an old battery set. This tool will give it to you, and it won't be a red-hot presence on your workbench when not in use—wasting energy and presenting a burn hazard.

You get the heat both *when* you need it and *where* you need it. The slender tip snakes nicely through small spaces, and because most of the heat is right at the end, you have less chance of accidentally burning any surrounding wiring. No, I'm not being paid by Weller, I'm just enthusiastic!

If I've talked you into acquiring a Weller-type gun, let me caution you about shopping carefully! Prices seem to vary widely among lumberyards, home centers, and hardware stores. My "Universal" came in at about $30. That may or may not have been the best possible deal, but I'd seen the same unit for as much as $10 more elsewhere. I also spotted the single-heat amateur model for the same price I paid for my dual-heat job.

FINISHING UP

Once I got the main tuning/bandspread subchassis mounted and wired, I was about ready to quit for the day. However, I did manage to accomplish a couple of more things.

One end of a long cylindrical form holding the receiver's mixer coils had come loose from its mounting. The rivet head holding it in place had pulled free. Drilling out the rivet head to replace it with a screw would have been difficult to do without damaging the coil, so I decided to use an adhesive.

The coil-support bracket was really too small for ordinary cement to be effective, so I tried packing a dab of Dap brand wood dough around the support and the end of the form. It set rapidly into a wood-like mass that firmly locked the form and bracket together. Finally, before calling it a day, I sprayed the volume-control interior and all switch contacts with contact cleaner/lubricant, working the controls several times to distribute the material.

See you next time, when we'll complete the reassembly and try another smoke test! ■

THINK TANK

(Continued from page 74)

```
Buffers = 15
Device = \DOS\Ansi.Sys
Device = \DOS\Driver.sys c:2/
  f:01
```

That's the kind of idea I got out of my DOS manual, but am still having problems with it reading the drive. I know you can help me with this. Your help would be greatly appreciated.

P.S. The floppy controller I purchased will run a 360k (5.25-inch), 720k (3.5-inch), 1.2MB (5.25-inch), or 1.44MB (3.5-inch) drive. The new drive is external and the controller has an external hookup.

—Dave Dudley, Amarillo, TX

The line for the floppy-disk driver should look like this:

```
Device = \DOS\Driver.sys
  / d:2/f:1/s:15
```

The /d:2 option assumes you already have two floppy drives (not including the one you wish to add), which will make the new one drive C: if you don't have a hard drive, or drive D: if you do have a hard drive. If you had only one floppy drive to begin with, that parameter should be /d:1 which will make the new drive the B: drive (regardless of the presence of a hard drive).

The CONFIG.SYS file containing that line should be in your root directory (not the directory you've placed the DOS 3.3 files in), and I'm sorry to disappoint you, but you may have to use DOS 3.3. Try editing the CONFIG.SYS file first, and if that isn't enough, properly install DOS 3.3 (don't just copy it) and use its DRIVER.SYS file.

Well, that's all she wrote for this month. Next time I'll get back to the usual run of circuits. ■

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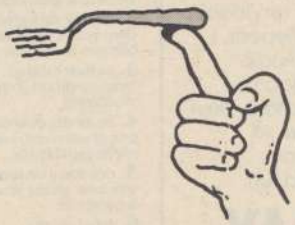

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Free Information No.		Page
—	47th Street Photo	4
10	AMC Sales	81
—	Antique Electronic Supply	94
—	Antique Radio Classified	94
—	Brookstone Co.	18
—	CBC International	94
—	CIE	25
—	Cable Ready Company	93
—	Claggk Video Offer	30
—	Claggk Reader's Club	89
—	Command Productions	77
18	Cook's Institute	87
15	Davis Instruments	87
—	EIA	CV3
—	Electronic Tech. Today	75, 95
—	Electronics Book Club	27
—	Firestik II	93
8	Fluke Manufacturing	CV2
—	Grantham	73
16	Heathkit	71
—	HighText Publications, Inc.	79, 86
—	ISCET	91
6	Kepco Inc.	29
17	MD Electronics	29
—	NRI Schools	11
—	Nu-Tek	95
—	Pacific Cable	95
—	Phillips Tech	94
—	P.E. Reprint Bkst.	88
5	Radio Shack	CV4
—	Republic Cable	95
—	The School of VCR Repair	94, 95
—	Tab Books	83
14	U.S. Cable	67
—	Video Dimensions	91
12	Viejo Publications	81
13	Zentek Corp.	67

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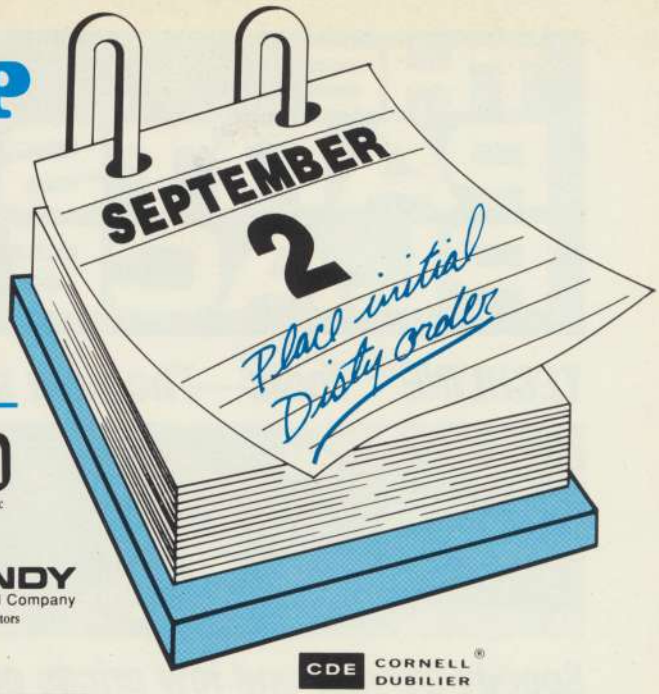

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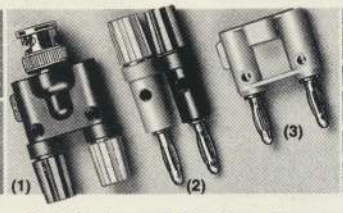

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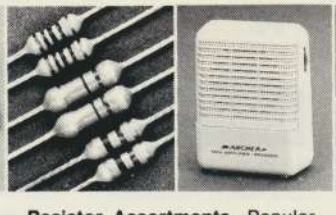

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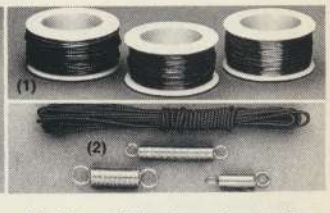

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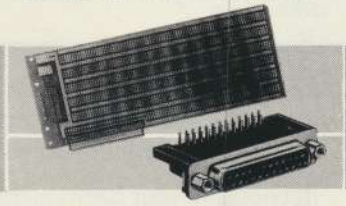

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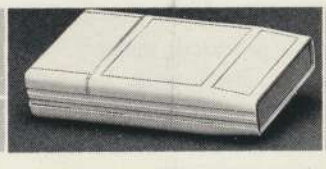

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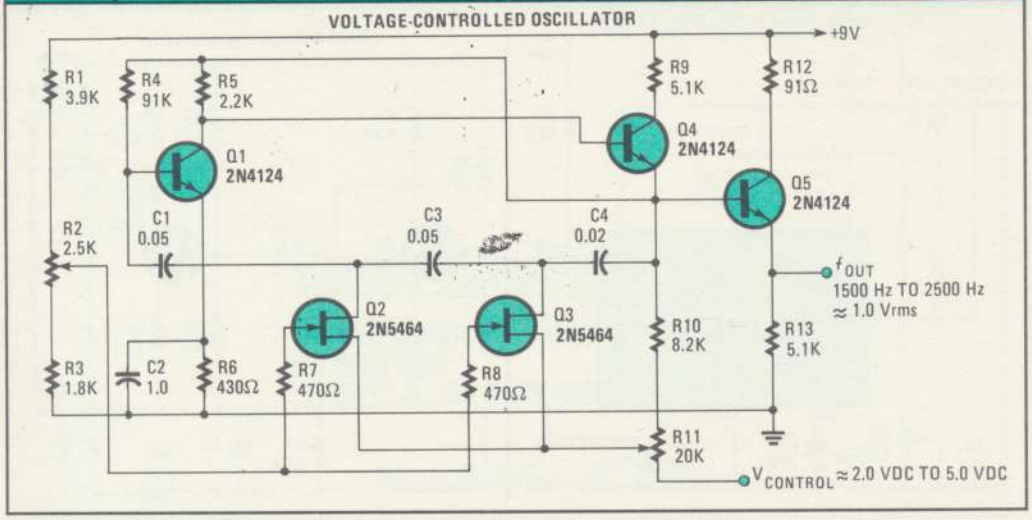

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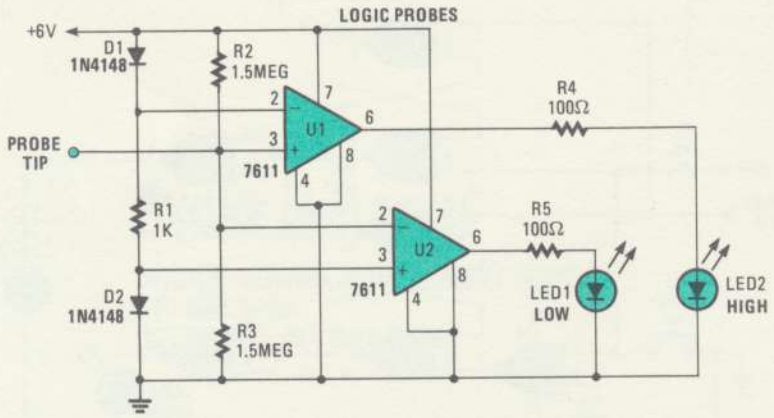

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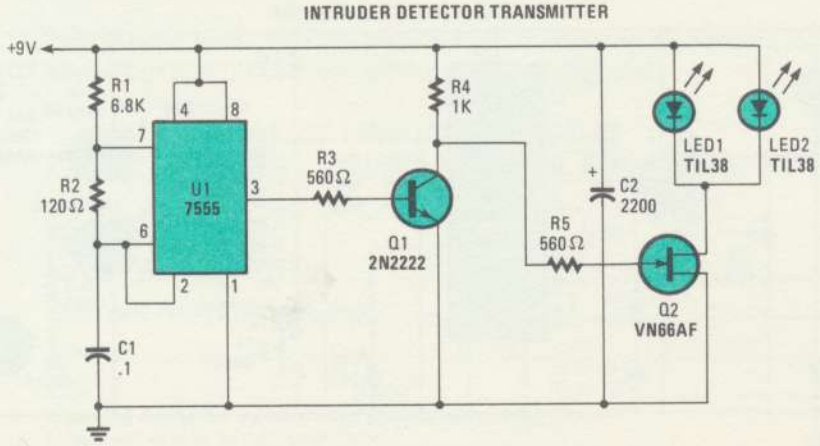

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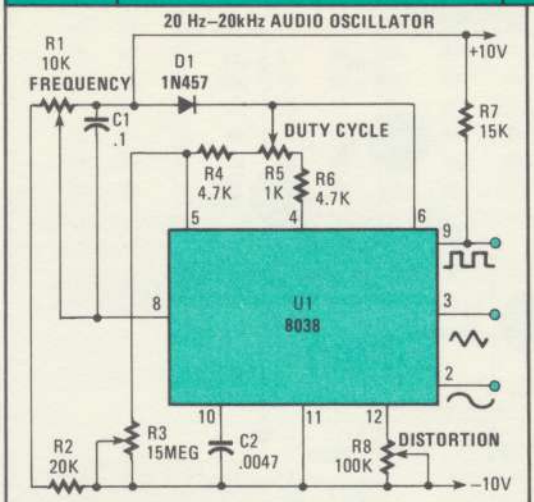

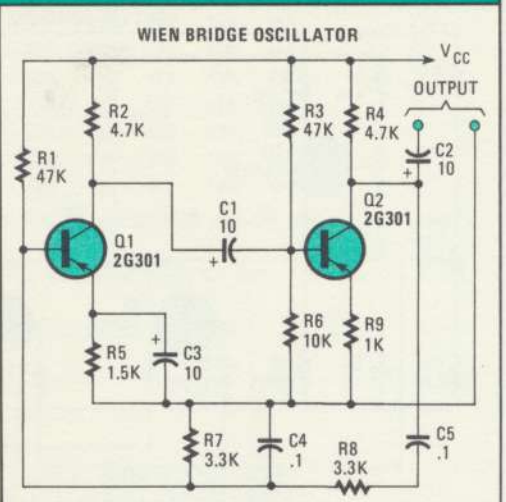

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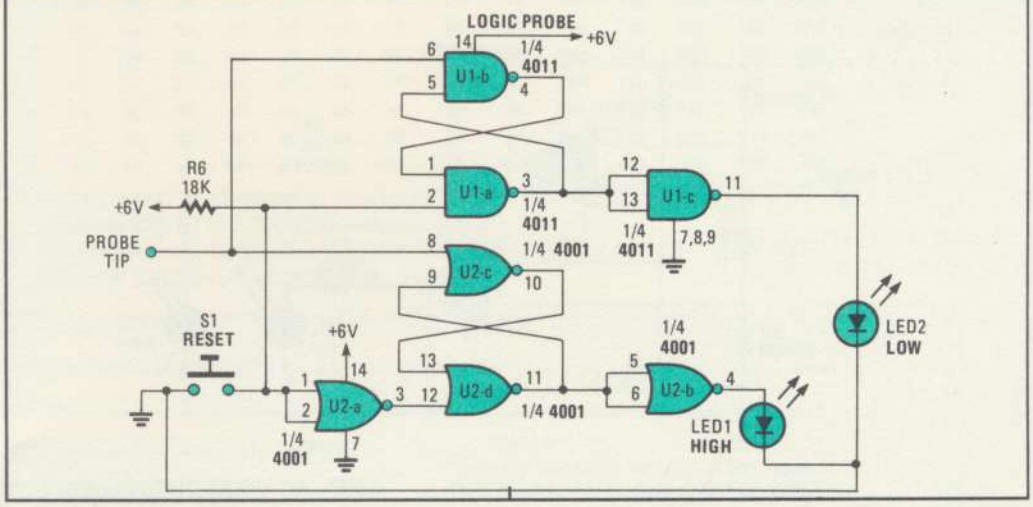

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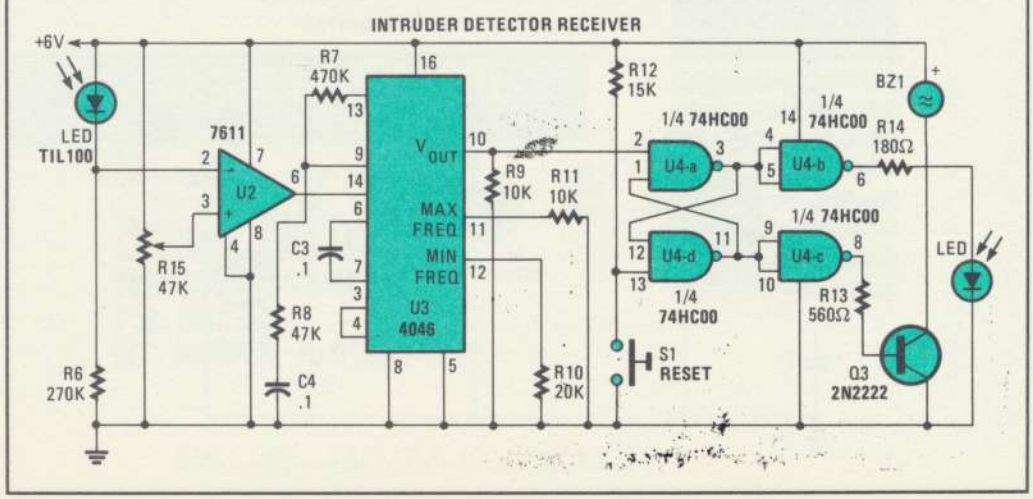
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